An Air Force Association Special Report

Delivering Combat Capability at Home and Abroad

Why can the US aerospace industry deliver systems for the foreign market more rapidly than it can for the United States Air Force?

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Executive Summary

Over the past 15 years, the United States and its allies have employed decisive military power to deter aggression, defeat armed incursions, protect oppressed nationalities, and counter terrorism. Airpower has played a key role—if not *the* key role—in the successful completion of each of these campaigns, starting with Desert Shield/Desert Storm in 1990-91 and proceeding through operations in Bosnia, Kosovo, Afghanistan, and, most recently, Iraq.

Interestingly enough, the aircraft that enabled the US Air Force (and, in certain cases, Coalition air forces) to be so successful all were the products of acquisition programs initiated in the early 1970s, a time in which the Pentagon installed a new process for management of its weapon programs. The programs at issue are those that produced the F-15, F-16, and F-117 fighters, the B-1B bomber, the A-10 attack aircraft, and the E-3A Airborne Warning and Control System aircraft.

This management process—known simply as the Defense Acquisition System, or DAS—is still in place. However, it has been drastically altered over the years by a large number of "reforms." The companion Air Force acquisition system, moreover, has undergone parallel reforms. Most if not all of these changes have been aimed at increasing the speed of the acquisition process. The Air Force process governs development and production of equipment for USAF use.

However, not all of the reforms that have been applied to USAF programs have directly influenced the management approach to foreign military sales (FMS) programs conducted over the same period. In recent years, moreover, America's aerospace contractors have taken a different path. They have at times worked directly with foreign nations and their air forces, engaging in so-called "direct commercial sales" (DCS).

Their pursuit of this activity has led to an interesting discovery: The DCS process, it turns out, is much faster and more efficient than the DOD/USAF system. It even has advantages over the more-streamlined FMS system. Simply put, American aerospace contractors in a DCS transaction are developing and delivering US-derived weapon systems—even enhanced systems—in much less time than is true for a contractor using the standard DOD/USAF procurement process.

This raises a question: Does the current acquisition system really offer the best route for equipping US forces with technologically advanced military capabilities in a timely and cost-effective manner? Is there a better way?

To answer those questions, this study undertakes some critical comparisons between the tactical aircraft programs in development in the early 1970s (F-15A, A-10A, F-16A), when the new Defense Acquisition System was initiated, and the two DCS programs (F-15K, F-16 Block 60) currently being developed today. The historical data would strongly indicate that the acquisition operating model established by the then-deputy secretary of defense, David Packard, allowed the three programs to develop and deliver effective tactical aircraft combat capability in relatively short periods—especially in view of current USAF and DOD tactical aircraft development programs.

These three programs delivered their first operational aircraft less than 60 months after the development contract was awarded. The first operational F-15 was delivered in 59 months after go-ahead, the F-16 in 48 months, and the A-10 in 40 months. Today, Boeing intends to deliver the first operational F-15K to South Korea in 42 months, and Lockheed Martin delivered the United Arab Emirate's (UAE's) first F-16 Block 60 in 48 months.

The study examines the attributes of the acquisition management system as it existed in the early 1970s and the management system used by Boeing and Lockheed Martin for the DCS programs. There are striking similarities.

The study also attempts to track the "acquisition reforms" which have been made to Packard's operating

model over the past 30 years. These reforms have come from numerous agencies involved in the system acquisition business. While the study does not—cannot—track the impact of each reform on the service's ability to deliver combat capability more quickly, the study does identify the range of reforms and allows the reader to come to his own conclusion.

It's interesting to examine the management relationship of the FMS programs and their cognate USAF programs during this period, as well as the schedule performance of these FMS programs. While the "acquisition reforms" were being instituted on the USAF side of the F-15 and F-16 programs, the FMS programs essentially continued to operate under the original Packard model.

The study documents the conclusion that there are fundamental practices that have allowed these programs to develop and deliver effective combat capability in a reasonable period. These practices are evident in the early USAF programs, current DCS programs, and FMS programs. The government should:

- Establish a pre-system acquisition activity in which needed technology, operational concepts, and system performance requirements are clearly established and agreed to prior to starting development.
- Once the development program has been approved and initiated, avoid changes or at least minimize the number of changes.
- Manage the program with a small management team and minimize the data and reporting requirements.
- Give the program management team planned resources as well as authority and responsibility to execute the program as planned.

The study concludes with a series of recommendations that would attempt to return to, or at least come closer to, the operating model established by Packard.

There have, in fact, been some significant changes made in DOD as a result of some acquisition reforms, such as the new methodology for identifying and prioritizing requirements. However, it is difficult to see how this new process will allow new technologies and concepts to be developed quickly without the Air Force having a strong influence in determining the appropriate system priorities. The re-institution of development planning driving integrated capabilities within the Air Force would be a significant first step. By doing this, the Air Force would have to develop integrated mission-area-capabilities-based roadmaps which establish the most effective development spirals for current and future systems. The advent of the spiral approach to incorporating new capabilities clearly sets the stage for going back to the future as the recommended approach.

Finally, recent organizational and policy changes made by the assistant secretary of the Air Force for acquisition have already started the Air Force moving in the right direction, but it will require a substantial change in the way the Office of the Secretary of Defense (OSD) and Congress involve themselves in the management of Air Force programs. Comparing the past success of the Air Force's F-15A/A-10/F-16A programs in the early 1970s with the current Boeing and Lockheed Martin DCS clearly demonstrates that small teams with sufficient management authority, minimal reporting requirements, and the necessary resources is the successful operating model. For the Air Force to be successful, OSD and Congress have to be willing to reduce their involvement in directing the execution of individual programs as well as the amount of information they request during the development and early production phases of the programs. All that is needed now is for the senior leadership to buy in to the remainder of changes that would posture USAF to get its combat capability at the same pace that foreign countries are now able to.

It is time to go back to the future.

— Dick Scofield

4

Delivering Combat Capability at Home and Abroad

Why can the US aerospace industry deliver systems for the foreign market more rapidly than it can for the United States Air Force?

Since the man in charge of the work himself determines what he needs as his work progresses, reviews at higher echelons of his detailed requirements are meaningless; such reviews make sense only when they are directed at the effectiveness of his work as a whole.

—Air Force Scientific Advisory Board, 1947

Whereas the general trend in large private and public organizations has been towards a small staff focused on identifying large issues for the consideration of the senior leadership, in [the Department of Defense] a large staff identifies relatively small issues. ... Today's [Office of the Secretary of Defense] staff bores into small issues regarding weapons inventories or stockpiles and conducts numerous analyses that are frequently inconclusive and contradictory. Too many of these analyses often involve issues that in isolation are too insignificant for senior leadership interest or action and do not lend themselves to meaningful aggregation. And it is by no means clear that the senior leaders of the department in recent years have encouraged the development and serious consideration of potentially troublesome major issues.

—Tooth to Tail Report on the
Planning, Programming, and Budgeting System, 2000

The Acquisition System

What is the purpose of the Defense Acquisition System? What are the characteristics of the environment in which it has functioned over the past three decades? Is it is possible to establish some measures of merit for purposes of this study?

The term "Defense Acquisition System" has different meanings to different individuals. It also can mean different things to the same individual. Thus it may be useful to establish some common reference points for assessing what we want the Defense Acquisition System to be and what role we want the US aerospace industry to play in it.

For purposes of this study, the DAS is the entity described in Department of Defense Directive (DODD) 5000.1, "Acquisition of Major Defense Systems," dated July 13, 1971. This document was the genesis of the system that has governed major defense system acquisitions for 33 years. It establishes three major criteria for determining whether the system is operating successfully. These three, with enumerated elements of success, are as follows:

- Mode of Operation—Does it have competent people with rational goals and clearly defined responsibilities; decentralized responsibility and authority consistent with urgency and priority; a single program manager with sufficient authority to accomplish recognized program objectives; minimal layers of authority between the PM and head of the service.

- Conduct of the Program—Is there a service definition of capability needed to support national strategies; application of sound judgment to management principles; strong and useable technology base that is not specific to any system; significant technical advances at relatively low cost; sound concepts; realistic development plans that meet identified needs; affordable production and operations.

- Attributes of the Program—Are there clearly stated system needs, spelled out in operational terms; practical trade-offs between capability, cost, and schedule; no premature introduction of detailed operational support considerations; program structure and resource allocation based on actual achievement; technical uncertainty continuously assessed; early operational assessment; contract type consistent with the risks; source selection based on contractor capability; lots of program information available to managers.

It is also useful to identify aspects of the environment that are deemed important by both government and industry managers. I have selected six of these environmental aspects in order to test the success (or failure) of a specific program or programs operating within the same environment.

- Mind-set or "culture"
- Leadership
- Total program perspective
- Clarity and stability of requirements
- Test and evaluation
- Stability of funding

Packard's New Approach

In 1969, the first year of the Nixon Administration, a Presidential blue-ribbon panel wrapped up a major review of several major programs (among them, the C-5A transport, F-111 fighter, and F-14 fighter) that had "failed" to meet program objectives. All had been conceived under the total package procurement approach that had been popular under Secretary of Defense Robert S. McNamara during the Kennedy and Johnson Administrations. The panel findings sparked a movement for reform, and, in the fall of 1969, the Pentagon began implementing a series of revisions to the policy governing acquisition of major defense systems.

There was a consensus that the McNamara way had to go. Frederick M. Scherer of the University of Michigan told the Senate Armed Services Committee in 1969 that McNamara's way of contracting introduced great rigidity into acquisition. This, he said, resulted in the kind of heavy bureaucracy that is "a great enemy to economy in the development of complex, technically advanced weapon systems."[1] Scherer also lamented the trend in the McNamara Pentagon toward centralization of weapon acquisition management in the Office of Secretary of Defense (OSD). As he put it, "There was widespread belief that 'better management' would solve the problem. But, in the complex bureaucracy of weapons and space systems acquisition, 'better management' has a tendency to be translated into 'more management,' with an accompanying increase in rigidity, delay, and the suppression of initiative."[2]

The 1969 policy changes were implemented by Nixon's new deputy secretary of defense, industrialist David Packard. It was with these changes that Packard "clearly dictated his insistence that OSD get out of the management business ... and that the services get back into it. If

Fig. 1

Responsibility in Weapon System Acquisition, Early 1970s

	Conceptual phase	Program decision	Validation phase	Ratification decision	Full-scale development	Production decision	Production	Deployment
Defense Secretary	D	A	D	A	D	A	D	D
Dir., Defense Research & Engineering	B	B	B	B	B	C	B	
Asst. Secretary, Installations & Logisitcs		C		C		B	B	B
Asst. Secretary, Comptroller	D	C	D	C	D	C	D	D
Asst. Secretary, Systems Analysis	D	C		C		C		
Service Secretaries	A		A		A		A	A

A = Primary responsibility B = Principal responsibility C = Secondary responsibility D = Monitoring responsibility

the Air Force is buying a system, the new code says, let the Air Force buy it and take basic responsibility."[3]

Packard's policy featured an eight-part acquisition cycle. A major defense program would progress from a concept phase through the validation, full-scale development (FSD), production, and deployment phases. In addition to those five phases, the cycle included three separate Milestone Decision Points. The milestones were interposed between concept and validation, validation and full-scale development, and FSD and production. These three specific milestone points offered the SECDEF the opportunity to determine the future (or demise) of a program. **Fig. 1** illustrates responsibilities in acquisition of major weapon systems consistent with Packard's guidelines and Department of Defense Directive 5000.1. That document was codified and released on July 13, 1971. Shortly afterward, Packard left the Pentagon to return to industry.

This study does not document the impact of each and every one of the acquisition reforms that have encrusted the system since 1971. However, it is interesting to note that, within four years of Packard's departure, OSD had published three major directives having to do with cost-analysis improvement, test and evaluation, and the design-to-cost concept. OSD also on Jan. 21, 1975, published DOD Instruction (DODI) 5000.2, titled "Major System Acquisition." Each added far-reaching "clarifications" to the original 1971 document. They had the effect of undoing, in large part, the operating mode set out in Packard's original plan. These were the first of many subtle but significant changes that revived direct OSD involvement in program execution.

Packard's DODD 5000.1 established the acquisition mode of operation as follows:

1. Responsibility and authority for the acquisition of major defense systems shall be decentralized to the maximum practicable extent consistent with the urgency and importance of each program.

2. The development and production of a major defense system shall be managed by a single individual (program manager), who shall have a charter which provides sufficient authority to accomplish recognized program objectives.

3. Layers of authority between the program manager and his component head shall be minimal.

4. The DOD components are responsible for identifying needs and defining, developing, and producing systems to satisfy those needs.

5. A development concept paper (DCP) will be prepared by the DOD component, following agreement with OSD on an outline, to define program issues, program objectives, program plans, performance parameters, areas of major risk, system alternatives, and acquisition strategy.

6. The DCP and the Defense Systems Acquisition Review Council (DSARC) will support SECDEF decision-making.

7. OSD is responsible for (a) establishing acquisition policy, (b) assuring programs are pursued in response to valid needs, and (c) evaluating policy implementation.

8. OSD and DOD components are responsible for program monitoring, but will place minimum demands for formal reporting on the program manager.

However, the 1975 document, DODI 5000.2, marked a major shift away from Packard's principles. First, it changed the whole concept of the DCP (No. 5, above). No longer did that acronym stand for development concept paper. Now it stood for decision coordinating paper. Responsibility for developing the document shifted from the indi-

vidual service component to OSD bureaucrats. The directive helpfully provided a full seven pages of guidelines dedicated to just the preparation of a DCP. By contrast, Packard's entire DODD 5000.1 paper took only six pages.

The new tone was made only too apparent in the 1975 document's General Guideline C:

> *The "initial" draft DCP is a military-service-prepared draft which, after preliminary review within OSD, becomes a "for-comment" draft. This "for-comment" draft is forwarded to all interested groups for review and comments. When revised to reflect these comments, it becomes the "for-coordination" draft, which is used (1) as a basis for DSARC review, (2) for final coordination, and (3) signature by the DSARC principals ... and the SECDEF.*[4]

To sum up: The DCP formerly had been a service-developed document specifying the military need and the plan for satisfying that need. Now it was to be a multiparty document produced through a coordination cycle which allowed many staff elements outside of the service to dictate system specifics which would be incorporated into the plan prior to approval.

Attachments to DODI 5000.2 established other objectives. They would limit the service component's authority for "defining, developing, and producing systems to meet their needs"[5] with two objectives:

> *—Describe management responsibility, structure, and planned management systems.*
>
> *—Establish objectives and limits of authority that are delegated to the cognizant DOD component(s) for conducting the next phase of the program.*[6]

Many of the "new DCP" objectives reflect a valid DOD need to ensure the services properly phase their programs and modernize in appropriate mission areas. However, other objectives started the process of diluting service authority to plan and execute programs to meet their mission needs.

It is interesting to note the timing of these changes: They came into force after the launch of those Air Force programs which so convincingly have proved themselves in combat over the last 15 years. It is also interesting that the high levels of OSD intrusion into service programs affected US service programs but did not directly affect FMS programs. This allows one to assess (or at least raise questions about) the impact of "reform" on systems management.

1970s: The F-15

On Dec. 23, 1969, the Air Force announced that McDonnell Douglas had won the competition to build the FX, the Air Force's proposed new fighter whose mission would be to win and maintain air superiority through air-to-air combat. The F-15 program went into full-scale development on Jan. 1, 1970. In March 1970, the Air Force selected Pratt & Whitney as the winner of the engine contract, following an 18-month competition with General Electric.

From the start of FSD in January 1970, McDonnell Douglas completed the F-15 critical design review in 16 months, rolled out the first development aircraft in 30 months, and flew the first F-15A in 31 months. The government released long-lead production funding for the first wing of F-15As only three months after the first flight of the first development aircraft. The DSARC approved full production for 30 operational aircraft just six months after first flight of the first development aircraft. And the first operational F-15A was delivered on Nov. 13, 1974, less than five years after source selection.[7]

The F-15A was the first of the programs to reflect the principles and mode of operation in Packard's DODD 5000.1. One who watched the process from a front-row seat was Charles Fowler, who worked for the legendary Johnny Foster, the director of defense research and engineering (DDR&E) under both Johnson and Nixon. Fowler saw a lot of Packard during his four-year tour in the Pentagon in the late 1960s and early 1970s. Fowler handled DDR&E's Tactical Warfare section, the overseer of several problem programs—the F-111 fighter, Mark II avionics, Cheyenne helicopter, M-70 Main Battle Tank, and Mark 48 torpedo. Tactical Warfare also had many of the new starts—the S-3A Viking aircraft, Patriot air defense system, AWACS aircraft, and the F-15.

Fowler recalls that "a number of preliminary meetings and discussions" led up to initiation of the F-15 program in 1969. Packard had by this time developed a strong aversion to "total package procurement," which the Air Force had proposed using. He concluded that a "cost-type" contract was appropriate for complex development programs. He also was appalled at the turnover rate for program managers and the large number of individuals in the program review loop. He had discussed these ideas at the various meetings, said Fowler, and had made it clear that he believed they were important. Fowler went on:

> *One day not long before the [scheduled] F-15 decision meeting, I was in the SECDEF mess for lunch, and Packard came in and sat with me. He talked about the forthcoming F-15 meeting and his firm requirement that the program be carried out*

using the principles he had described. I asked him if he'd like me to prepare a memo telling the Air Force what he wanted. He replied with a question: "Fowler, did you ever herd cattle?" No. "Well, when you're trying to get cattle to go into a corral, you work them gently up near the open gate. If you try to drive them in, some maverick will bolt and the whole herd will disperse. If you just keep them together and wait, before long one of them will wander into the corral and others will follow, and, after a while, they're all in there and you can close the gate."

At the decision meeting, the Air Force proceeded to describe how it proposed to run the program. A CPIF [cost plus incentive fee] type contract would be used. A BG [Brig. Gen. Benjamin N. Bellis] had been chosen as the PM. There was a commitment for a minimum tour of three years, with a possible promotion to two stars in place. His reporting chain went directly to the four-star commander of Systems Command at Andrews, then to the Chief, skipping all of ASD [Aeronautical Systems Division] at Wright Field, the staff at Systems Command, and the Air Staff. So it went; the Air Force had incorporated every idea from Packard's earlier comments. As the briefing continued, Packard looked more and more concerned and he would frequently interrupt to ask, "Do you think that'll work?" "Do you really want to do that?" In every case, the Air Force answered positively and enthusiastically so.

At the end of the briefing, Packard, still looking somewhat doubtful, said well, since you're sure this will work and that's the way you want to run the program, I'm going to approve it. The Air Force left the meeting convinced they had won a major battle in getting Packard to let them do the program THEIR WAY. In reality, the herd was in the corral and the gate was closed.

Before the meeting ended, Fowler continued, Packard added that he especially liked the part where the PM didn't have to deal with all those Air Force staff folks and could concentrate his efforts on running the job.

In keeping with minimizing such disruptions, he said, looking at Foster, me, and a few other OSD folks, he would be sure his staff also didn't get involved with the details of the program or place any undue burdens on the program manager.

In a relatively short period, said Fowler, Packard had identified those major acquisition problems that could be fixed on his watch. Moreover, he had taken steps required to fix them. He had decreed that:

- The Pentagon would use cost-type contracts, not fixed-price contracts, for all development programs.
- Program manager tenure would be substantially increased.
- The reporting chain from program manager to the top would be very short.
- There would be minimal, if any, staff intrusion into a program.
- One could exercise production options only when appropriate development accomplishments were demonstrated, period.

Packard was displeased with growth in peripheral specifications, known as the "ilities" for reliability, maintainability, and so forth. He was equally unhappy that large numbers of people working those areas had become a prime source of acquisition inefficiency. He proposed to make drastic changes that essentially eliminated all such items—and the groups that oversaw them. "He was, unfortunately, dissuaded by the services from implementation," Fowler concluded.[8]

The F-15A program was, in fact, run in a manner consistent with Packard's desires and DODD 5000.1 principles. Bellis, the program manager, was a single individual responsible and accountable for managing all aspects of the program. Not everyone was happy with some of his decisions, at least at the time, especially when it came to adding new requirements. However, he managed to keep the program balanced and on track to the delivery of effective combat capability at the earliest possible date.

It should be noted that no one ever thought of the F-15 as anything other than a premier air-to-air fighter. Bellis, the F-15 System Program Office (SPO), and the contractor team never lost sight of that reality. In fact, the program had a motto: "Not one pound for air-to-ground." Everyone focused on the need to keep the program on track for specified air-to-air capability, nothing more and nothing less. All future requirements, over and above those dealing with the air-to-air mission as contained in the program management directive, were deferred, to be incorporated in later models as required and directed.

The Air Force and the F-15 contractor also had an agreement that there would be no "change orders." Any changes to the contract would have to be agreed to by both parties and executed through a supplemental agreement.[9] The effect of this approach was to create a single contract baseline applicable to the entire F-15 team, both Air Force and contractor. The effectiveness of this approach and of Bellis' management has been validated by the evolution of the F-15's capability and performance over the past three decades. The F-15 program was the first true tactical fighter "spiral development" program, exemplifying the management approach that is the current operating model for the entire Department of Defense.

1970s: The A-10

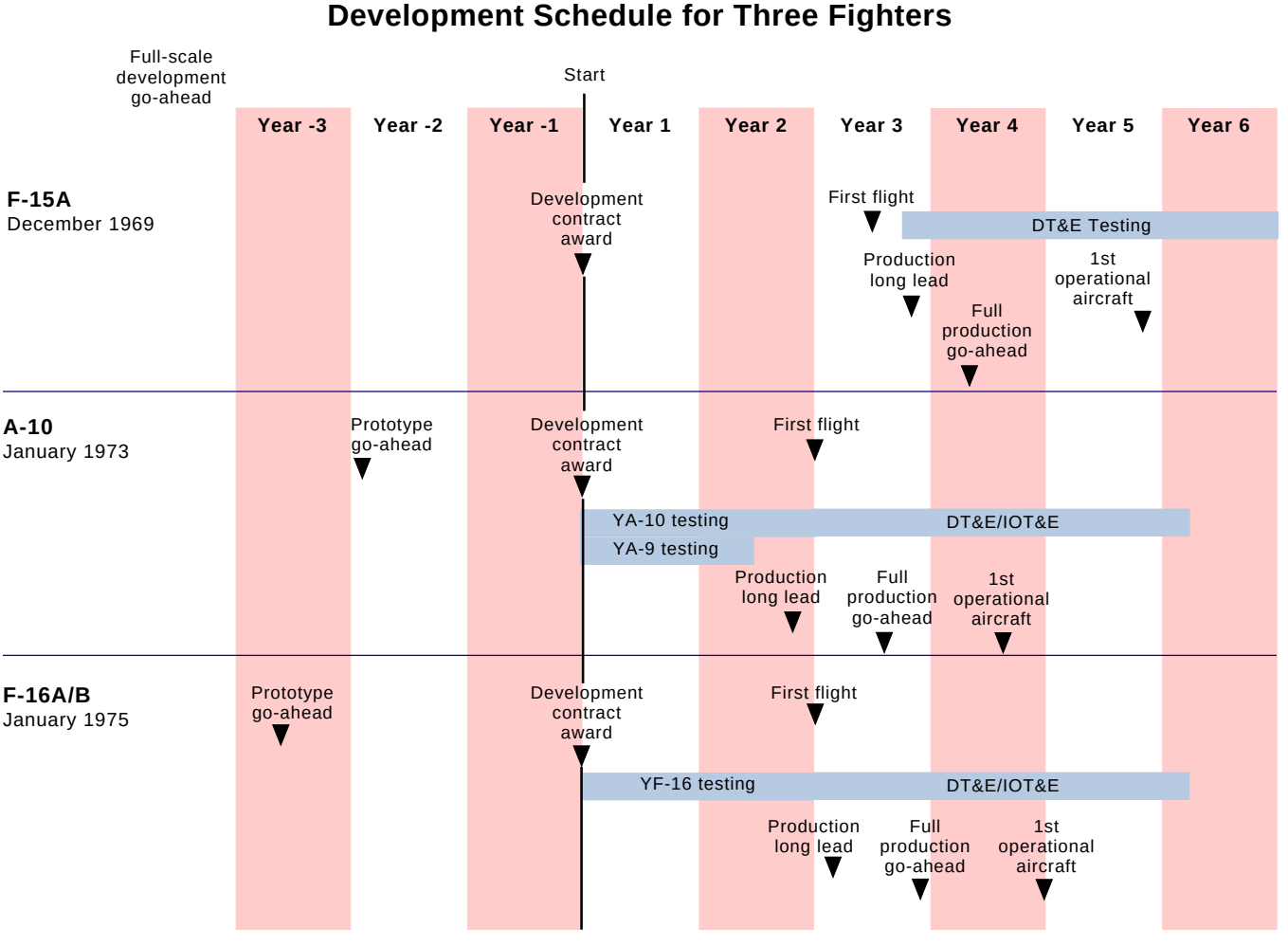
The program plan and schedule achieved by the F-15A was typical of Air Force tactical fighter aircraft programs of the time. As shown in **Fig. 2,** the A-10 and the F-16 fighters achieved similar program plan performance.

The A-10 program was conceived in the late 1960s as the AX program. The Air Force was putting together a traditional program management plan for this new aircraft. However, it was not to be. The General Accounting Office, which had recently conducted a study for the Senate Banking Committee, recommended that the AX program be considered as a candidate for competitive prototyping, using austere manning and limited documentation. OSD agreed and directed the Air Force to proceed on that basis. The Air Force in May 1970 released a request for proposal (RFP) for an airplane design that could be built for $1.4 million unit flyaway cost for 600 aircraft at a maximum production rate of 20 aircraft per month. As for performance, the AX was supposed to do the following:

- Deliver ordnance accurately near friendly troops.
- Be highly maneuverable.
- Operate at low speeds under low-ceiling and low-visibility conditions.
- Survive probable air defenses.

The AX concept was built around three design principles: (1) minimize total systems cost, (2) minimize aircraft attrition, and (3) maximize target destruction. The RFP directed the use of only nine military specifications, those which dealt with flight safety and aircraft

Fig. 2



DT&E Developmental test & evaluation
IOT&E Initial operational test & evaluation

handling qualities. The entire engineering requirements attachment ran to just 20 pages. The strategy was to encourage the use of off-the-shelf hardware.

The Air Force in December 1970 selected Northrop and Fairchild Republic to participate in a 26-month prototype competition. This competition included the development, construction, and flight-testing of two prototypes by each contractor. It culminated in January 1973 with the award of a full-scale development contract to Fairchild. The Air Force then used prototypes from both companies for more than two years of performance validation and operational testing even before arrival of the first developmental test and evaluation (DT&E) aircraft. **Fig. 3.**

Fig. 3

YA-10 Testing During Full-Scale Development

- YA-10 airframe/GAU-8 gun compatibility tests
- Stores carriage/separation tests
- Preliminary evaluation of in-flight refueling capability
- Definition of stall/post-stall spin characteristics
- Maintainability/reliability/supportability testing
- A-7D/YA-10 flight evaluation
- Icing flight tests
- Evaluation of selected production avionics
- Air loads testing
- Evaluation of aural stall warning device
- Evaluation of control system modifications
- Evaluation of aerodynamic slats
- Evaluation of drag reduction options

This was a significant step. The prototypes served as useful tools for revealing oversights and reducing important technical risks, as was pointed out by a RAND study:

> *The Air Force used the first two YA-10 prototypes for DT&E and IOT&E flight testing until delivery of the first full scale DT&E aircraft. By the time the Air Force placed both prototypes in flyable storage in June 1975, they had accumulated 1,139 flying hours in 821 flights over 37 months. Joint DT&E and IOT&E Phase I testing by contractor, AFSC, TAC, and AFTEC [Air Force Technical Evaluation Center] pilots accounted for 797 flight hours, between March 1973 and June 1975. The prototypes proved valuable in the qualification of production equipment, in the conduct of operational tests not undertaken during the competitive flyoff, and in the evaluation of alternative design approaches to fix deficiencies revealed during the flyoff.*[10]

The A-10 program's first production DSARC IIIA occurred in July 1974. Just seven months later, the Air Force achieved first flight of an FSD DT&E airplane. This was a source of concern to some in Congress, particular Rep. Joseph Addabbo (D-N.Y.), a member of the House Defense Appropriations Subcommittee, who worried about technical risks of moving so fast. Lt. Gen William J. Evans, then deputy chief of staff for research and development, responded that technical risks had been greatly reduced through prototyping.

The Air Force had managed the program with minimum staffing, consistent with direction from the Air Force leadership. The original request for proposal set the tone for this mode of flexible management. It stated, in part:

> *The [Air Force] management relationship with the contractors ... will be one of minimal involvement, increasing at the test-flying stage to one of appropriate Air Force participation. The Air Force involvement ... will be limited to "overview visibility," consisting of monthly visits to the contractors by selected SPO personnel. ... Air Force approval, surveillance, control, or directive actions will be minimal unless ... the objectives of the requirements documents will not be met and government participation is required.*[11]

During the competitive prototyping phase, the SPO was manned at about 30 persons, half of whom were engineers. By the start of FSD, the number had increased to about 80 persons.

> *AX (A-10) SPO director Col. James E. Hildebrandt operated under two important advantages: constant program requirements and considerable operational autonomy. The unchanged set of requirements throughout the competitive prototyping phase distinguishes the AX program from the Lightweight Fighter [LWF] (F-16) program, which began as a technology demonstration program and evolved into a multinational fighter development. Without the burden of new or changing requirements, both the SPO and the contractors generally met the originally established objectives on schedule and within budgeted costs. Colonel Hildebrandt kept his superiors informed through quarterly progress report briefings to the USAF Air Council, the Secretary and assistant secretaries, and the Chief of Staff, after review by ASD and AFSC commanders.*[12]

By mid-1974, it had become apparent that Fairchild did not have the kind of experienced workforce necessary to effectively take the A-10 program from a developmental environment to a high-rate production program. Both the Air Force and Fairchild made a number of management personnel changes, clarified the roles and responsibilities of the leadership, and shortened the lines of communication between program officials and top decision-makers.

However, it is most interesting to note certain Pentagon actions that were taken during this period.

Despite the serious transition issues, OSD in mid-1975 proceeded with DSARC IIIB, giving the go-ahead for production. This came before completion of IOT&E Phase II flight testing. At the same time, the A-10 fatigue test article had experienced a fuselage failure. Fairchild and the Air Force came up with a new structural arrangement that fit within the existing frame-forging design and basic aircraft dimensions. However, the new component had not been tested at the time of the DSARC IIIB approval.

Because this decision was made prior to the completion of DT&E, the A-10 line showed no break between development to production. By using the data from the YA-10 prototypes and the A-10 development aircraft, there was almost three years' worth of flight-test data based on 2,200 flight-test hours split evenly between the two types of aircraft. The program baseline schedule established at the time of the development program contract called for a max rate of 20 aircraft a month with the final delivery of the 729th production airplane in mid-1980. However, delays started soon after that due to Congressional actions (YA-10/A-7 flyoff), Air Force decisions to live with funding cuts, and OSD reductions in planned production rates and funding levels. The increasing inflation rates of the early and mid-1970s only worsened the situation. The 733rd airplane was delivered at the end of 1982.[13]

1970s: The F-16

The Lightweight Fighter program was the seedbed of today's F-16 multirole fighter. It, the A-10, and the F-15 programs were conceptualized at about the same time in the early 1970s. Indeed, the three programs were interrelated in many ways.

The A-10 and F-15 aircraft stood at opposite ends of the combat spectrum. The A-10 filled the need for low-and-slow close air support, but had no air combat capability. The F-15 met high-end, air-to-air needs, but had no air-to-ground capability.

The F-15 also was expensive. Even Robert C. Seamans Jr., the Secretary of the Air Force, had publicly expressed concern about whether the Air Force could afford to buy the hot fighter in sufficient quantities.[14] In addition, some critics argued that the F-15 was too big and heavy for the combat environment. What was really needed, said these critics, was a highly maneuverable fighter in the 20,000-pound weight class but with a substantial radar capability.

In fall 1971, Packard proposed to Congress a new, $67.5 million prototyping program. The Lightweight Fighter was one of 12 items included in the package. Packard told Congress that the Department of Defense was:

> *interested in pursuing a lightweight fighter, principally to demonstrate technology, high maneuverability, and good controllability throughout the performance range of the aircraft. There have been a number of advances in [these areas]. We would like to take a specific aircraft design and demonstrate it. Because of the technical risks involved in some of these particular features, we have not been able to include an optimum combination of these design ideas in our approved development program.*

The "technical risks" of which Packard spoke included high-acceleration cockpits, sidestick/fly-by-wire flight controls, automatic variable camber, neutral stability, and high-aspect-ratio thin wings, which were prone to flutter, lift, and drag problems.[15] The Air Force Prototype Study Team recommended "a dual-source prototype program, in which the design and performance objectives would be stated as goals, not rigid requirements; design trade-offs would thereby be encouraged."[16]

The Air Force acknowledged that successful prototyping required unusual management practices—in Air Force parlance, "adaptive management." The prototyping study team formulated five major principles for managing the prototype programs. They were:

- Use small government and industry organizations. The Air Force program manager should have maximum responsibility for program decisions.
- Use contractor-formatted data, when data are required, to limit reformatting costs.
- Minimize controls and program documentation within both industry and government. Emphasize on-site assessment in lieu of contractor documentation. Waive many regulations such as Production Plan (AFSCM84-3), Integrated Logistics Support Plan (AFSC/AFLC 400-10), and Value Engineering (AFR 70-16). Encourage the contractor to simplify his own management techniques.
- Defer both managerial and technical elements not directly related to the prototype program. Such elements include configuration management, supporting technical data, and reprocurement data.
- Tailor testing to attainment of specific program goals. Category I, II, and III testing, required by AFR 80-14, should not be conducted. Rather, the contractor and the Air Force should jointly perform both the airworthiness demonstration and the flight evaluation, with the Air Force entering at the earliest possible date.

Responsibility within the Air Force for the prototype programs was to reside in a special Advanced Prototype Programs Office in the Aeronautical Systems Division of Air Force Systems Command.[17]

The Air Force issued the LWF program request for proposal on Jan. 6, 1972. RFPs for past programs frequently required the use of several hundred pages of text. In contrast, the main substance of the RFP ran to only 10 pages and the total (including legal boilerplate) only 54 pages. The RFP explicitly limited contractor responses to 50 pages of technical information and 10 pages of management data. The RFP indicated that funds for the total prototype program would not exceed $90 million, counting government-furnished equipment or government-furnished aerospace equipment and contractor and government base support.

The RFP's statement of work took one page. It required

the contractor to design, develop, and fabricate two prototypes; certify the flight safety of each aircraft throughout its envelope; conduct a flight-test program to verify the satisfaction of the performance/design requirements; train four Air Force pilots; provide logistics, engineering, and maintenance support for about 12 months of testing (hours to be specified by the contractor); provide certain data; and prepare and submit a final report, including recommendations for follow-on engineering development. The contractors had six weeks to respond.

Barely four months after USAF issued the RFP, the service—on April 14, 1972—announced the winners to be General Dynamics and Northrop.[18]

Management of the LWF program was originally established in the Prototype Program Office, formed within ASD on Aug. 27, 1971. The director of the office reported to the ASD deputy for systems and later directly to the commander of ASD. This shortened the communication lines and removed a layer of management from the program. The Air Force did not establish a separate SPO for the LWF program until October 1974, several months after the decision to proceed with full-scale development.

The number of program office personnel assigned to the LWF program was remarkably low throughout the prototype period, particularly when compared to the number on other more conventional programs. As late as January 1974, there were only 50 to 60, not counting representatives from Europe in the program office. After selection of the F-16 and the start of full-scale development, the staffing level grew rapidly despite reported attempts to enforce a 125-person limit. There were a number of contributing factors: the need to move beyond a prototype program, activities necessary to support an operational system, and the F-16s emergence as a multinational program, where failure could have international repercussions.

As was the case with the AX Prototype Program, the test program was designed and conducted by a joint test force consisting of three constituencies: the contractors, Systems Command's flight-test organization, and USAF's user-oriented test community (first Tactical Air Command, later the Air Force Test and Evaluation Center). The test programs began four months apart. YF-16 testing kicked off in February 1974 and that of the YF-17 in June 1974.

It was not the intention, at least not at the start, to fly the aircraft against each other. However, the test programs were soon forced to reveal a winning design. The Air Force was to make a source selection in January 1975. When that happened, the Air Force scrapped its plan for 12-month programs and reprioritized its test points. On Jan. 13, 1975, USAF selected the YF-16.

Things moved quickly after that. The first of eight development aircraft rolled out in October 1976. First flight occurred on Dec. 8, 1976. Thus, the F-16 was flying less than two years after the contract award. The program received approval in January 1977 to release long-lead funds for the first production lot of F-16s. The first operational aircraft was delivered to Tactical Air Command in January 1979, four years after the start of the development program.[19]

> *Perhaps, the most notable observation from this overview is that decisions to enter both full-scale development and full-scale production were made surprisingly early. The decision to commit one of the LWF designs to full-scale development was made about six months before the completion of the prototype test programs (recall that the YF-16 and YF-17 test programs were roughly only 10 months and 6 months in length, respectively). The decision to start rate production of the F-16A, represented by the DSARC IIIB go-ahead, was made about the time the last FSD test aircraft was delivered. As a result, delivery of production aircraft to the US Air Force started somewhat before completion of the development test phase.*[20]

The significance of this pace was not lost on Evans, the deputy chief for research and development. In an appearance before a committee of Congress, he pointed out:

> *Contractors structure their programs as much as two years in advance to provide for an orderly development program and a logical buildup of personnel, equipment, and other resources for the production phase. If there is a delay in entering production, the personnel on hand must either be paid for standing by with no work or be laid off and a new workforce then hired and trained later on. Each alternative adds to costs. Besides this, the contractors and vendors interpret delays as increased program risk, which cause price quotations to become more conservative. ... In both the A-10 and F-16 prototype programs, the decision to enter production occurred before all of the FSD test results had been evaluated and the deficiencies corrected. However, the remaining risks seemed within acceptable bounds and worth the gamble to permit production continuity to be maintained.*[21]

All three programs were executed successfully and in relative short periods. Viewing them in retrospect, one sees that all three had certain management characteristics that contributed to their success.

Packard's approach, embodied in DODD 5000.1, created a climate in which the Air Force assumed the key leadership and decision-making role in the setting of requirements. Program execution was decentralized, with authority pushed down to the level of the Air Force program office. The using commands, test community, HQ USAF, and OSD functioned in support roles. Each program was led by a seasoned program director, who had decision-making authority and responsibility for the program. The program office staffs had experienced functional experts. The program offices maintained close working relationships with Tactical Air Command users, AFTEC testers, and the contractor teams. The emphasis was on delivering usable combat capability as quickly as possible. A program's needs, objectives, and priorities were stated clearly. Performance requirements were tailored for a reasonable initial operational capability (IOC). The test community took advantage of the early prototype aircraft where available to draw early conclusions regarding operational capability.

Most important, the Air Force was willing to risk ramping up production before it had completely solved known developmental problems in the aircraft. This kept production aircraft appropriately phased right behind development aircraft. In this, DOD and Air Force senior leaders strongly supported program directors.

As for Congress, it was generally supportive of the military's management process. The record indicates Congress made no significant funding changes in these programs throughout the periods of development. Only later, after the three programs had gone into rate production, did lawmakers begin to impose any cuts in program funding.

Each program had its own technical and management problems to overcome. However, the Air Force dealt with each in a forthright manner. During periodic reviews, problems were reported up the Air Force chain and taken to OSD as required. The program reporting requirements were minimal, consistent with Packard's edict. Of particular interest to this study is the fact that both the F-15 and the F-16 went on to generate significant foreign military sales.

What was it about the early 1970s acquisition system that allowed this to happen?

I think first one would have to look at the environment that existed at the time that these three programs began.

First, the Vietnam War was coming to a close. The Air Force had made heroic contributions to US efforts in Southeast Asia. However, it had used equipment that, for the most part, it had on hand in the early 1960s, having deferred fighter modernization in the face of high wartime costs. By the late 1960s, it had become clear to all concerned that the Air Force needed a new generation of aircraft suited to modern conflicts and capable of handling a growing threat posed by improved Soviet aircraft. There was a growing sense of urgency that something had to be done across a broad range of capabilities.

Second, there was an existing, collaborative Air Force and industry infrastructure, one that continuously addressed the concepts and technologies necessary for future airpower capabilities. The Aeronautical Systems Division at Wright-Patterson was seen as the center of this infrastructure. It was this aeronautical "enterprise" that had the concepts ready in the late 1960s.

Third, Packard's presence, leadership, and influence helped create an environment of cooperation and support for the programs at all levels of the acquisition system. Constituencies formed during concept development had a deep interest in turning their concepts into reality. Everyone was "on the team," contributing to the overall success of the program by ensuring that their functional responsibility was complete and fully supporting the program objectives. The day-to-day execution of the program was left to the program director and the SPO, while the important staff functions within the Pentagon were handled by resident experts in the commands, HQ USAF, and OSD.

Fourth, Congress provided timely support for DOD and service budget requests during the early cycles of each program, particularly in the development phases. While there were some occasional stipulations as to how the money was to be spent, or what special tests had to be done, the program director usually was free to manage the acquisition effort within program guidelines.

Finally, the programs benefited greatly from feedback that was generated through the Quarterly Program Management Review process within the Air Force. This information went on up to OSD and Congress as necessary. This process not only kept the senior leadership well informed on program progress and potential problems but also gave the program director the opportunity to ask for help without fear that someone would simply take over the management of the program. Typically, the leadership of the Air Force, and on occasion OSD, would provide any additional assistance to the program manager (PM), consistent with his requests and timing.

Throughout the 1970s and early 1980s, acquisition management responsibility and authority essentially flowed from Headquarters USAF through Headquarters Air Force Systems Command to the product division responsible for specific capabilities (i.e., Aeronautical Systems Division for aircraft, Electronic Systems Division for C3, and so forth). Each product division was organized as shown in **Fig. 4,** with the SPO the point of day-to-day program execution. Each product division commander was responsible for staffing the SPOs, consistent with program priority, phasing, and technical complexity. The commander was to allocate resources to meet Air Force mission needs through timely execution of programs in his division. At the same time, the commander had to support the AFSC commander's responsibilities to the Chief of Staff and the Secretary of the Air Force.

On the other hand, Air Force Logistics Command was responsible for most Air Force foreign military sales programs. This was done through the command's International Logistics Center (ILC), now known as the Air Force Security Assistance Center. The ILC's charter was written in 1978. Its responsibilities increased greatly in the Reagan years, when Washington presided over a massive expansion of security assistance programs. Just as product divisions were responsible to USAF operational commands, the ILC was responsible for delivering combat capability to foreign air forces. The ILC over the years integrated a customer's needs into ongoing USAF programs, producing a "win-win" situation. The Air Force got its equipment, and so did the foreign clients. **Fig. 5** illustrates the then existing organizational structure which supported the allocation and integration of ILC responsibilities into the SPO.

In the early 1970s, the Air Force and foreign military sales management structures had much in common. This was particularly true of the ways in which the two received program direction, funding, and management authorities. And the similarities existed despite the fact that the two management entities were supported by two separate Air Staff elements. The Deputy Chief of Staff for Research and Development (AF/RD) oversaw US programs and the Deputy Chief of Staff for Logistics and Installations (AF/LG) oversaw foreign assistance cases. In both cases, execution was decentralized.

Moreover, day-to-day management was quite similar.

Fig. 4

Acquisition Command Structure, Early 1970s

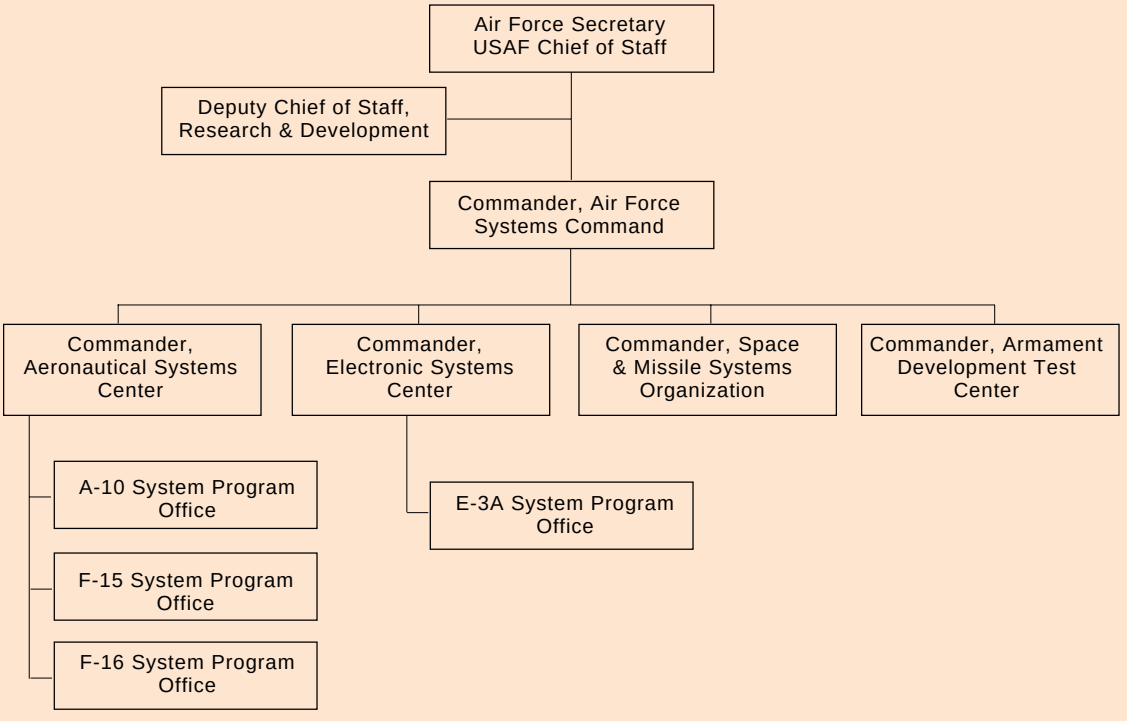
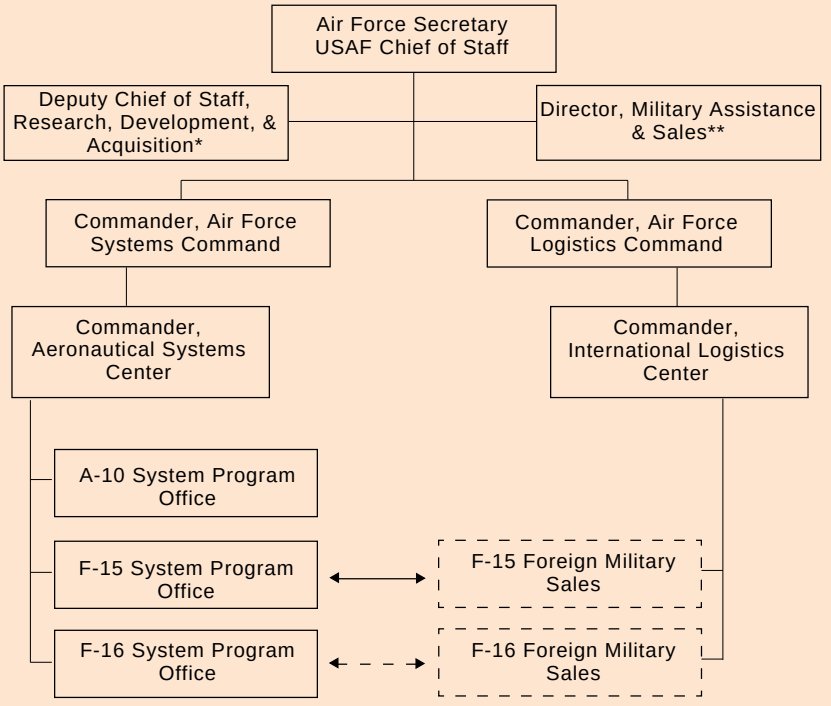


Fig. 5

Acquisition Command Structure 1978-92



* Deputy Chief of Staff, Research, Development, & Acquisition, was eliminated upon creation of the Assistant Secretary of the Air Force for Acquisition position in 1986.
** Director, Military Assistance & Sales, function shifted to Director, International Programs, in 1979. That office was eliminated in 1990.

The USAF program director was responsible and accountable for execution of the total program, including support for the FMS program. USAF program objectives were stated in the development concept paper. The program director had authority to trade off cost, schedule, and performance, so long as he met stated objectives and coordinated with USAF operational users, logistic support commands, and the FMS program manager. The FMS program manager, while still responsible to his foreign customer, would manage the FMS case within the total program, making trade-offs as necessary to avoid negative impact on the USAF program.

At times, the USAF program director made decisions that pleased neither, and much discussion and negotiation would follow. The program director might also have to make changes that caused the dropping of a DCP objective. In these cases, the program director, working with the contractor, and the resident operational command and the logistic command representatives, would typically develop a "get-well" plan, after working a series of alternatives within the SPO, that all of the management team could buy into. This agreed-to plan was then normally briefed up through the management of the contractor(s), the using operational command, Air Force Logistics Command, and AFSC prior to going to the Air Force leadership in the Pentagon and, if required, on to the appropriate OSD offices.

The great majority of these kinds of issues generally would be addressed in the Quarterly Program Management Review cycle. If the issue were critical enough, the program director would bring it and a recommended solution to the Air Force leadership in an out of cycle briefing. The Air Force leadership, recognizing that the program director was the officer responsible for the success of the program, would for the most part accept his recommendations. In those few cases where it did not, the leadership would ask the program director to prepare more options.

This mode of operation recognized several important facts about development of complex weapon systems:

1. Developmental systems that incorporate new technologies will eventually experience difficulties requiring the management to make trades, some of which may have an impact outside of the program.

2. Personnel in the program office—including representatives of operational and logistic support commands—are the ones best qualified to handle these situations.

3. The program director is the individual best qualified to pull together workable, balanced system solutions in the fastest way possible.

4. If a program director is to be held accountable, he must

be given latitude to develop and carry out revisions to the program plan.

This mode of operation was totally consistent with Packard's philosophy as enunciated in DODD 5000.1. Moreover, it was consistent with the Air Force's leadership philosophy concerning operational flight units.

FMS cases typically were structured and executed a bit differently, in that the foreign country was procuring a mature system with known capabilities. The FMS program's day-to-day execution was well-integrated into the USAF program management structure. However, the FMS program manager had the same responsibility and authority for his piece of the total program. The FMS program director typically had the same reporting requirements. Usually, FMS programs underwent minimal reviews at higher USAF headquarters, but foreign customers would do them quarterly. FMS program issues were usually directly related to the USAF program. If the US program director thought the FMS impact significant enough, he would include it his quarterly review.

Foreign requirements generally are stated in terms of the existing capabilities. In recent years, some foreign countries have been willing to pay for developmental work to achieve a specific level of performance. However, in the majority of FMS cases, the identified deliverables are packaged. The package includes any required development activity, appropriate tests to validate performance, a stated quantity of production aircraft, and logistics support. All are procured using a single firm fixed-price contract with an agreed-to funding profile and a cash flow commitment schedule.

With such commitments in hand, US aerospace contractors are willing to quote favorable prices and schedules when negotiating FMS cases. The same holds true for the relatively new direct commercial sales concept. Today's FMS and DCS programs look very much like the total package procurement structure of the 1960s. The risk is relatively low because of the maturity of the aircraft being procured.

However, that is not the case with the two most recent cases of direct commercial sales—the United Arab Emirates purchase of F-16 Block 60 fighters and South Korea's purchase of advanced F-15K fighters. These two systems take advantage of new technologies. This has produced operational performance superior to that of USAF variants. Such development activities, which include flight-test validation, have been included in the firm fixed-price contracts that look very much like total package procurement programs. The US aerospace contractor manages development risk within the total contract value.

DCS and FMS contractors do not view this as unmanageable risk because of the up-front contractual agreements on required performance and capabilities and the firm-price commitment to a minimum number of production airplanes and logistic support needs. A contractor needs to be convinced he can count on fulfillment of the original contract. If so, he can manage the program risks so as to deliver the specified capability and make a profit, too.

"Reforms," 1970-Present

The F-15, A-10, and F-16 tactical aircraft all started out as major acquisition programs within Packard's DODD 5000.1 concept. In the original directive, the Secretary of Defense retained authority to initiate or increase program commitments and to have these commitments reflected in the program objective memorandum submitted by the component service. Packard also established a "mode of operation" policy:

> *Successful development, production, and deployment of major defense systems are primarily dependent upon competent people, rational priorities, and clearly defined responsibilities. Responsibility and authority for the acquisition of major defense systems shall be decentralized to the maximum practicable extent consistent with the urgency and importance of each program. The development and production of a major defense system shall be managed by a single individual (program manager) who shall have a charter, which provides sufficient authority to accomplish recognized objectives. Layers of authority between the program manager and his component head shall be minimum. ... The assignment and tenure of program managers shall be a matter of concern to DOD component heads and shall reflect career incentives designed to attract, retain, and reward competent personnel.*[22]

The pure Packard ethos didn't last long, as a large number of Pentagon "clarifications" soon started to roll in, re-establishing the OSD staffers as key decision-makers in structuring programs as they proceeded through the DSARC approval process. These "clarifications" added workload to the system program offices, but they provided only a hint of the "reforms" that were yet to come.

The 1982 Nunn-McCurdy Act was the first of a series of Congressional actions aimed at improving the way the Department of Defense conducted and reported on major defense system programs. After that, it seemed that each year would bring a new initiative to deal with one or more aspects of acquisition management. Many dealt directly with contacting policy, contract clauses, and contract dispute resolution. **Fig. 6.**

Between 1984 and 1986, Congress took three legislative actions that have had a dramatic impact on the speed with which defense systems can be fielded to meet operational needs. The first of these actions, the 1984 DOD Authorization Act (Public Law 98-94), created Office of Operational Test and Evaluation (OT&E) and established a level of independence for the OT&E test community.

The next two were probably more significant. The Defense Acquisition Improvement Act of 1986 created the new position of undersecretary of defense (acquisition and technology). The DOD reorganization act of 1986 (better known as the Goldwater-Nichols Act) revised the role of the Joint Chiefs of Staff in acquisition and in the determination of requirements. These two acts clearly elevated decision-making on major systems and gave OSD greater authority in establishing performance requirements, program capability, and program execution thresholds.

The combined result of these three acts was additional bureaucratic involvement in determining service needs and the establishment of rigorous developmental performance thresholds for production. There is little doubt that these changes have resulted in longer acquisition cycles.

The requirements process, led by the JCS vice chairman and the Joint Requirements Oversight Council, has evolved over the past two decades. It is forward-looking by nature and is continuously looking for new capabilities brought about by the maturation of new technologies. In the process of assessing new technologies, officials make judgments about how they will affect future operational capability. In the case of tactical fighter aircraft programs, they assess concepts such as range, speed, survivability, and weapons delivery.

At a certain point, these technology-based assessments become "requirements." Some are "hard" requirements (that is, "must-have" capabilities). These are translated into system-level Critical Performance Parameters (KPPs), thereby establishing a level of performance that the new system must meet in order to achieve the operational requirement. In some cases, the KPPs are allocated to subsystems rather than systems. This subsystem is most likely the new technology piece of the full system. The establishment of a KPP sets the need for a specific level of testing, to be conducted by the operational test and evaluation community. This usually must be done before the DSARC recommends the system for full-rate production.

The result has been a structuring of programs into phases—competitive prototypes first, followed by a short hiatus to select the winning contractor. Next comes the formation of a development program—the actual start of the acquisition process. It comprises use of modeling and simulation systems, subsystem laboratories, a system-level laboratory, and developmental test articles. Near the end of the development phase, the Air Force launches an overlapping production phase, starting with low rate initial production. It is followed by high-rate production—provided, of course, that all of the KPPs have successfully passed OT&E testing.

The net effect is that "concurrency" of development and production phases has been all but eliminated. This stretches out the program, delaying achievement of operational capability while increasing total program cost. All of this is done in the name of reducing technical risk.

We have seen in the past decade an unintended but negative consequence of these changes. New technologies are evolving at a rate faster than the pace of the system development cycle. This has led to diminished manufacturing sources to support the program. The problem does not, as in the past, emerge slowly over a full life cycle of a system, but right away, in the development

Fig. 6

Acquisition Initiatives and Legislation

1971	DODD 5000.1 (major systems acquisitions)
1972	Commission on Government Procurement
1973	DODD 5000.4 (Cost Analysis Improvement Group)
	DODD 5000.3 (Test & Evaluation)
1975	DODI 5000.2 (major systems acquisitions)
	DODD 5000.28 (design to cost)
1976	OMB Circular A-109
1978	Defense Science Board Acquisition Cycle Task Force
1979	Defense Resource Management Study
1981	Carlucci Initiatives; Defense Acquisition Improvement Program
1982	Nunn-McCurdy (thresholds)
1983	Office of Federal Procurement Policy Act
	Grace Commission
1984	DOD Authorization Act (Public Law 98-94) created Office of Operational Test & Evaluation
1984	Competition in Contracting Act (CICA)
1985	DOD Procurement Reform Act
	DOD 5000.43 (streamlining)
1986	Packard Commission
	Goldwater-Nichols Department of Defense Reorganization Act
	Defense Procurement Improvement Act
	Defense Acquisition Improvement Act
1987	DODD 5134.1 (Undersecretary of Defense, Acquisition)
	DODD 5000.49 (Defense Acquisition Board)
1989	Defense Management Review
	Ethics Reform Act
1990	Defense Acquisition Workforce Improvement Act
1991	Revised DODI 5000.2 (major systems acquisitions)
	Section 800 Panel created by 1991 National Defense Authorization Act (Public Law 101-510)
1994	Defense Acquisition Reform
	Federal Acquisition Streamlining Act (FASA)
1995	Federal Acquisition Improvement Act (FASA II)
	Air Force Lightning Bolts 1
1996	Federal Acquisition Reform Act
	Clinger-Cohen Act
	Rewrite DOD 5000 Series
1999	Air Force Lightning Bolts 2
2000	Revised DOD 5000 Series
2002	Agile Acquisition Initiatives (Air Force Lightning Bolts 3)
2003	Rewrite DOD 5000 Series

period. Thus, it is possible to be working toward a production go-ahead while, at the same time, major components are becoming obsolete.

It is not possible to trace the impact of each acquisition reform over the past 25 years and demonstrate that each has had a specific impact on current day programs such as the F/A-22 and F-35 fighter programs. This is true for several reasons. No one ever has performed a system engineering analysis or a system process analysis to determine the impact of reforms on the process. In my opinion (as someone who had to make the reforms work in the field), it is fair to say, though, that most, if not all, were implemented in an ad hoc fashion, generally in response to specific issues or events. It was not obvious to us at the program office level that there had been a serious analysis to assess not only the intended but also the unintended consequences.

The next major reform initiative was the Defense Management Review (DMR), initiated in 1989 by President George H.W. Bush. The DMR addressed the entire acquisition process, addressing the two major elements altered by the 1986 legislation—the requirements process and the Defense Acquisition System. This had all grown out of the work of the so-called Packard Commission in the late 1980s.

The President's terms of reference for the DMR focused on the Defense Acquisition System. Major barriers had to be cleared away if DOD wished to fully implement the Packard Commission's recommendations. Efforts to date had not produced the results envisioned by the panel. This only underscored the magnitude of the problems identified by the commission, the scope of the solutions it offered, and the persistence to manage major DOD acquisition programs. As the commission saw it, successful commercial and governmental projects were characterized by:

- Clear command channels—the clear alignment of responsibility and authority, preserved and promoted through short, unambiguous chains of command to the most senior decision-makers.
- Program stability—stable funding and management, predicated on an agreed baseline for cost, schedule, and performance.
- Limited reporting requirements—adherence to the principle of "management by exception" and methods of ensuring accountability that focused on deviations from the agreed baseline.
- Small, high-quality staffs—reliance on a few specially trained and highly motivated personnel.
- Communication with users—sound, early understanding of user needs and a proper balance of cost, schedule, and performance.
- Better system development—aggressive use of prototyping and testing, investment in a strong technology base, greater reliance on commercial products, and increased use of competition.

When considered in this framework, it was apparent that the Packard Commission's recommendations intended to make more fundamental changes in the Defense Acquisition System than had yet been accomplished. Additional actions were required, said the DMR report, including "steps that substantially depart from or go well beyond DOD's and Congress' efforts to date."[23]

The DMR report was submitted to the President in July 1989. Since then, Congress has passed the Federal Acquisition Streamlining Act (1994), Federal Acquisition Improvement Act (1995), Federal Acquisition Reform Act (1996), and several other smaller pieces of legislation. The Department of Defense has completely rewritten the DOD 5000 Series documents twice and revised them twice more. The combined net effect of these initiatives, over the years, has been to take the management authority and responsibility for identifying and developing capabilities in support of service needs away from the services and invest it in OSD and Congressional staffs. The involvement of these staffs at the lowest levels of program execution has to be, in my judgment, one of the major contributors to the (slow) pace with which we field new operational capability today. At the same time, we continue to strive to achieve (or be driven toward achieving) a full-up capability with the very first aircraft (system) delivered, instead of developing a program plan that evolves incremental capabilities over time—consistent with maturing technologies and the spiral development approach.

By now, it is difficult to find the six basic characteristics mentioned above. Most of the reform initiatives have produced only more centralization and standardization. The Air Force's recent decision to return program executive officer (PEO) functions to the various product centers is the first step in many years toward the management philosophy that proved so successful in the early 1970s.

During these years, the Air Force issued a series of acquisition reform initiatives. Three rounds of these acquisition reform initiatives have produced a total of some 30 separate initiatives called "Lightning Bolts." The purpose was to improve efficiency and make it easier to achieve program performance on schedule and within budget. Some of these Lightning Bolts provided focused direction in specific areas. However, many clashed with the principles of Packard's original DODD 5000.1 charter. Moreover, they were launched without the benefit of systems engineering or process engineering evaluation of their impact.

Their ability to achieve the desired results is questionable at best. One case in point is Lightning Bolt 3[24], which dealt with reducing the size of a SPO:

> *Program office "Slim Fast" Plan—Goal was to reduce size of our program offices by 50 percent. Team developed program office sizing tenets based on management of classified/special access required [SAR] programs and industry downsizing achievements. Provided program managers a toolbox of lessons learned to dramatically reduce military, civilian, and contracted support program office staff. (Average program office was reduced by at least 35 percent.)*

True, this initiative reduced the size of the SPOs. However, no one changed the management operating model to make it consistent with the operating model of these SAR programs. If one compares the operating mode established by Packard's DODD 5000.1 and the management of the F-117, B-2, and other SAR programs, one finds great consistency. This is also true of the F-15, A-10, and F-16 programs.

One widespread but false assumption about the management of SAR programs is that the SPOs throw out the published regulations and processes associated with acquisition management. The truth, however, is that these programs are typically managed by using the principles contained in the regulations and the procedures but using them as guidelines rather than unbreakable rules. It is true that SAR program managers have had the authority to waive regulations, but we often found it wise to stick with them. These documents provided a common management frame of reference for operation as a team. All SPO personnel have had the authority to make fast decisions consistent with program directions and goals. The ability quickly to deliver combat capability comes from pushing decision-making down to the lowest level and giving the SPO the power to implement such decisions without having to go up the chain of command for approval. Finally, but importantly, there were few reporting requirements.

These features of SAR management significantly reduced workload and allowed the small team to focus on the future instead of the past. The F-117 SPO usually had about 12 full-time workers, backed up by another 30 or so part-time functional experts who provided support as required. This was the strongest SPO-contractor team I have ever observed. Much of the credit for the program's success goes to the test community and the Tactical Air Command user representatives. Most operational capability issues and problems were resolved at the working level. I don't recall any issue being bucked up to a higher headquarters for resolution. The user never asked for a "specification" capability. TAC would tell us what it wanted the machine to do and let us figure out how to make it work. We didn't always get it right the first time, but we made everything work within the time required. First flight of the first aircraft came only 20 months after award of the development contract. First operational delivery came 15 months after first flight. Limited IOC came only 13 months after that. Then, everyone moved on to increase the F-117's combat capability through spiral development.

As can be seen, Lightning Bolt 3 didn't address all of the operating model considerations critical to making a small SPO achieve desired results. A broader point, however, is this: To achieve acquisition reform without falling victim to negative unintended consequences, one must take a system engineering approach to the problem. I have not been able to find where this has been done during the past three decades, as we have reformed and re-reformed Packard's D0DD 5000.1 of July 1971.

Two other initiatives further hindered the ability of program directors to make the kinds of day-to-day decisions needed to keep a program moving forward on schedule. The first concerns integrated product teams (IPTs). In the late 1980s, IPTs became the organizational model of choice at the SPO level. (Some would argue they were implemented in the early 1970s.) The idea spread quickly, taking multiple forms at different management levels within the Air Force and at OSD. One consequence was that a number of staff personnel at the upper levels of the Air Force and OSD started to meddle more. They became involved in the day-to-day execution of the program through their membership on an "Integrating IPT" at the Air Force level and "Overarching IPT" at the OSD level. These Integrating and Overarching IPTs were created with the best intent. The idea was to establish high-level teams empowered to break down barriers, speed resolution of issues, and enhance coordination so as to help the program director keep the program moving forward. The reality is that IPT members have gradually become more and more involved in working program-specific (technical and management) issues, adding requirements for reviews and conditions for proceeding. All of these factors have the effect of slowing down the program through delayed decision-making.

Moreover, many Air Force major programs were saddled with an additional management chain. This one was created through establishment of so-called "CEO meetings." These quarterly meetings have in the past generally included the CEOs and other senior executives of major contractors and senior executives of the Air Force, the Chief of Staff, the Secretary of the Air Force, the service acquisition executive, and other selected officials. Of course, the Air Force program director and the contractor program manager would participate, usually briefing on the program status and any issues that could not be resolved at the program management level. Needless to say, a certain amount of time and resources must be committed to these meetings. The real delay, however, comes in having to wait for the CEO meeting to get a decision.

The need to support IPT and CEO meetings and implement their action items can badly stretch a small SPO and undermine day-to-day execution of the program. When you add funding instability, shifting requirements, uncertain industrial base capabilities, and SPO turnover, managing the program becomes a major challenge.

Go back and look at the mode of operation that Packard established. Then consider the organizational structure changes that have occurred through the adoption of the IPT-centric management approach and the added communication links that evolved with those and other structural changes.

The evolution of the CEO meeting has been an interesting phenomenon. It illustrates how we tend to take one management technique used successfully in one case and apply it to other programs even though the circumstances may be very different. Use of CEO meetings first appeared in the early days of the Advanced Technology Bomber program, before it became the B-2 program. The ATB program in the early 1980s was a special access required type. Government and contractor program offices were

unable to argue for resources through the normal channels. The concept of the CEO meeting was devised in 1983 as a means for keeping the program on track. As a result, officials of the Air Force and major contractors (Northrop Grumman, Boeing, Vought, Hughes, and General Electric Aircraft Engines) met quarterly to assess resource issues and bring to the surface any bureaucratic impediments to program execution.

The meetings were limited to CEOs and contractor program managers, the ASD commander, and the SPO director. The concept permitted no strap-hangers from the staffs. Meetings were well-structured and usually lasted about six hours. Problems usually were fixed expeditiously. We certainly didn't have the staff laying on lots of requirements for data to get the support of the CEOs. As the ATB became the B-2 and the B-2 management structure and processes became more "white," however, the Air Force began to apply the technique to other programs. Their formats and attendance guidelines were not the same. Nor was the responsiveness and productivity of those meetings of the same caliber, in my estimation. The point is, there is no one-size-fits-all approach. Programs need to be able to structure management approaches and operating models suited to their own priorities and complexities.

Fundamentally, the SPO is an integrated product team. SPOs were created to properly integrate all of the disciplines essential to providing a capability. The key word is capability. My judgment is that the SPO has the best chance to be a well-integrated product team if it is small. As a SPO grows in size, and communication links proliferate, integration becomes difficult. This is especially true if one also eliminates specifications and standards. When you establish multiple IPTs on one program and eliminate specifications and standards, integration may well become impossible.

The discussion up to this point is only in reference to horizontal integration. When one attempts to use IPTs to achieve vertical integration at numerous levels of management, the potential for gaps or disconnects increases exponentially with each new IPT.

Over the past 12 years, I have served on a number of special teams called in to help get troubled acquisition programs back on track. I therefore have been able to assess such programs at close range. In each case, members of a review team concluded that the horizontal IPTs were not so much "integrated" as "independent"—that is, independent from each other. When one overlays the vertical IPT structure on top of the horizontal structure, the complexity of maintaining a definitive technical baseline, a configuration baseline and a contract baseline becomes increasingly difficult. In most of the observed cases, they were disconnected. DODD 5000.1 and the DMR had it right when they claimed that successful program execution hinged on maintaining technical, configuration, and contractual baselines.

Divergences Since 1980

The purpose of this study is to look at the current USAF acquisition process and analyze its success or failure relative to the system that is used to carry out programs under the auspices of the foreign military sales or direct commercial sales programs. As we have seen, the management structure and processes of USAF programs have changed considerably in the more than three decades that have elapsed since Packard introduced his landmark DODD 5000.1 approach in 1971. These changes have brought about major slowdowns in the USAF's fielding of combat capability.

However, the structure and processes used in FMS programs (and now DCS programs) have not changed all that much over the years. The situation is still essentially the same as it was in the mid-1970s, when the Air Force established the International Logistics Center as the focus of foreign efforts to obtain American combat capability in a timely manner. These efforts now even extend to development of new and more-advanced capabilities.

Comparisons of the two approaches—the system that provides weaponry to the United States Air Force and the one that supplies hardware to the air forces of foreign nations—can best be conducted by examining the F-15 and F-16 programs over the lives of both programs. This is especially valid in light of the fact that each program has produced different configurations for United States Air Force and for foreign clients.

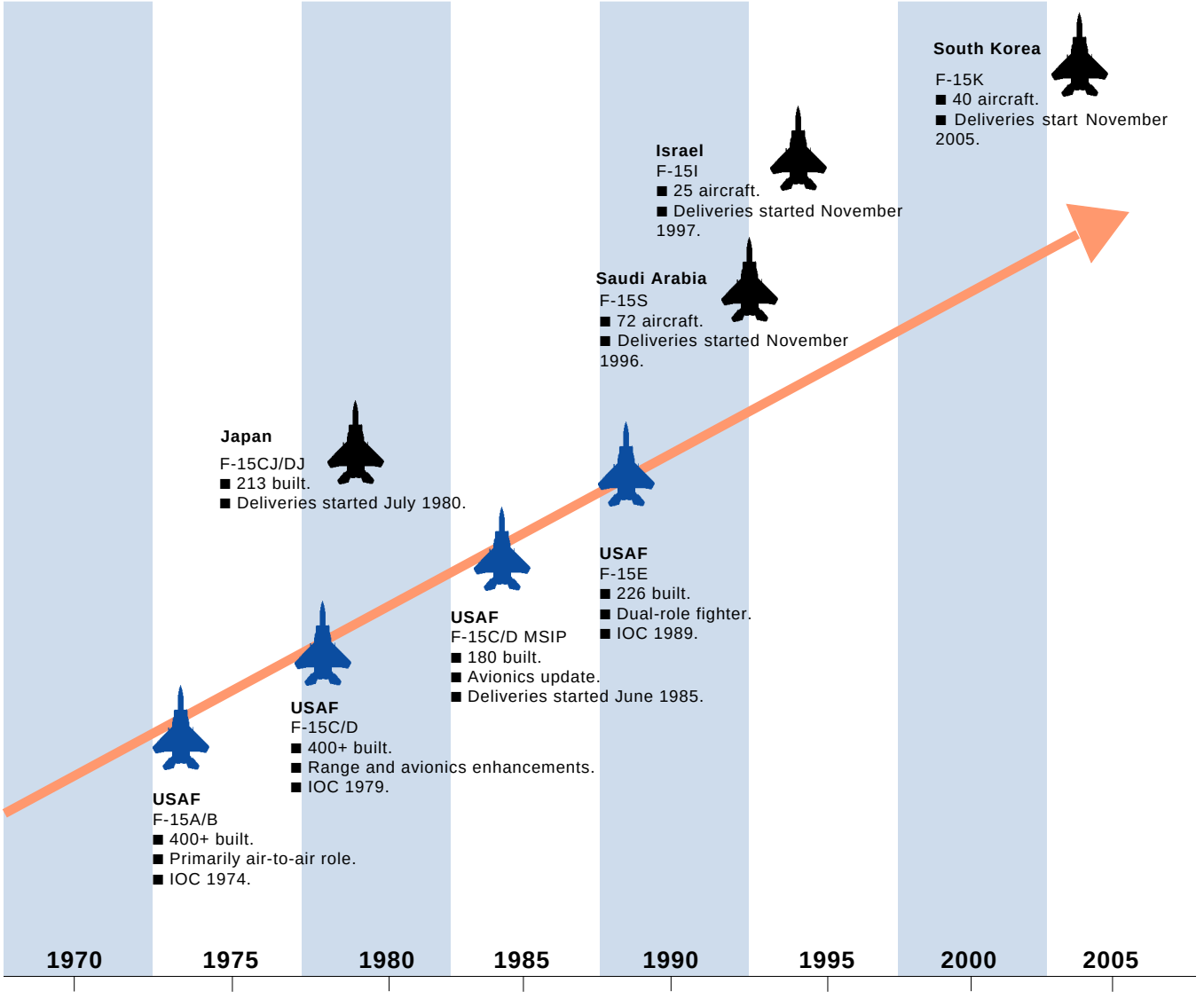
F-15, Foreign and Domestic

The production history for the F-15—as seen in **Fig. 7**—began in 1970s with the original USAF A model. The aircraft then began to evolve, proceeding through USAF F-15 Multistage Improvement Program (MSIP), which led in the mid-1980s to the F-15C/Ds and to the F-15E variant in the late 1980s.

The first FMS case featured delivery to Israel of F-15A/B aircraft in 1977, F-15C/D models in the 1980s, and early 1990s, and advanced F-15I models in the late 1990s. Saudi Arabia also procured F-15C/Ds in the early 1980s and 1990s, as well an advanced F-15S aircraft in the late 1990s. Japan has procured F-15J/DJ aircraft for two decades.

Fig. 7

F-15 Worldwide Fleet



The evolution of the Air Force F-15—plotted on orange line—proceeded from the A/B model to a multirole "E." Early on, Israel bought basic A/Bs (not shown), but the first foreign development (plotted above the line) was Japan's F-15J model. Then came Saudi Arabia's "S," Israel's "I," and South Korea's "K." All featured new technologies later incorporated in USAF Eagles.

Through 2001, United States industry had produced a total of 1,536 F-15s. Of this number, 416 (or 27 percent) were produced for friendly foreign air forces and 1,120 for the United States Air Force. The synergies of these sales not only helped produce economies of scale but also allowed the United States to continuously modernize the Eagle's capability. The "forward-fit" of these capabilities into FMS aircraft allowed USAF to "retrofit" them into USAF fighters. Having the power to do this became important over the past two decades, as the Air Force's own budgets tightened.

In some cases, the FMS clients simply bought what was being produced for the US Air Force, a highly cost-effective step. In other cases, countries would invest in new techologies and/or new configurations better suited to their needs. The trend today, however, is in a different direction. Foreign air forces seem to want low cost, high reliability, and even better performance through modernization—all within a competitive commercial environment.

The classic case is the F-15K fielded by South Korea's air force. This aircraft was produced as a result of a 2002 DCS deal between Boeing and the Korean government. It calls for production of 40 advanced tactical fighters between 2005 and 2008. The F-15K not only takes advantage of 30 years of F-15 development and production but also incorporates many new capabilities not to be found on any other F-15s in the world—including USAF's. These improvements are listed in **Fig. 8.**

The F-15K is the latest example of the evolution of the basic Eagle fighter. Over several years, Boeing and South Korea held a series of discussions on the matter. They established the new fighter's capabilities and interoperability requirements, the number of aircraft to be fielded, the timing of their delivery to the South Korean Air Force, the engine of choice, and the future logistics-support structure. This activity culminated in an integrated program plan involving both DCSs and a FMS case that addressed all of these considerations in one planning package with a total value of $4.3 billion.

The F-15K production history is shown in **Fig. 9.** The F-15K schedule contains several interesting features. One is the speed with which the F-15K gets into flight test. Another is that production aircraft are to be delivered to the Koreans before the conclusion of flight testing. This is unusual. True, the F-15 is considered a mature airframe. However, no one in the program management business would doubt that the effort needed to bring about the F-15K configuration constitutes anything other than a significant developmental effort. It requires a disciplined approach to certifying Operational Flight Profile software and achieving the necessary weapons certification. The program plan calls for a 14-month weapons integration and certification effort, including participation by the Air Force's SEEK EAGLE office at Eglin AFB, Fla. This will include 150 flights aimed at certifying three new weapons.

South Korea's program contains many positive aspects.

Fig. 8 F-15K Configuration Changes

Production of 40 Aircraft with 2005-08 Deliveries

Avionics Upgrades
Combined Interrogator/Transponder
ARC-232 UHF/VHF Radio
Dual Embedded GPS/INS
ADCP & new six-inch LCDs
TACAN
Link 16
JHMCS
DAS Flight Data Recorder
Digital Video Recorder

Armament
AIM-9X
AGM-84 Harpoon
SLAM-ER
500-pound JDAM
15 Station Mil-Std 1760

Sensor Changes
RWR (ALR-56C(V)1)
ICS (AN/ALQ-135M)
Chaff/Flare (AN/ALE-47) with Tail Boom Dispensers
Radar (APG-63(V)1)
3rd Gen Target & Nav Pods
Added IRST System

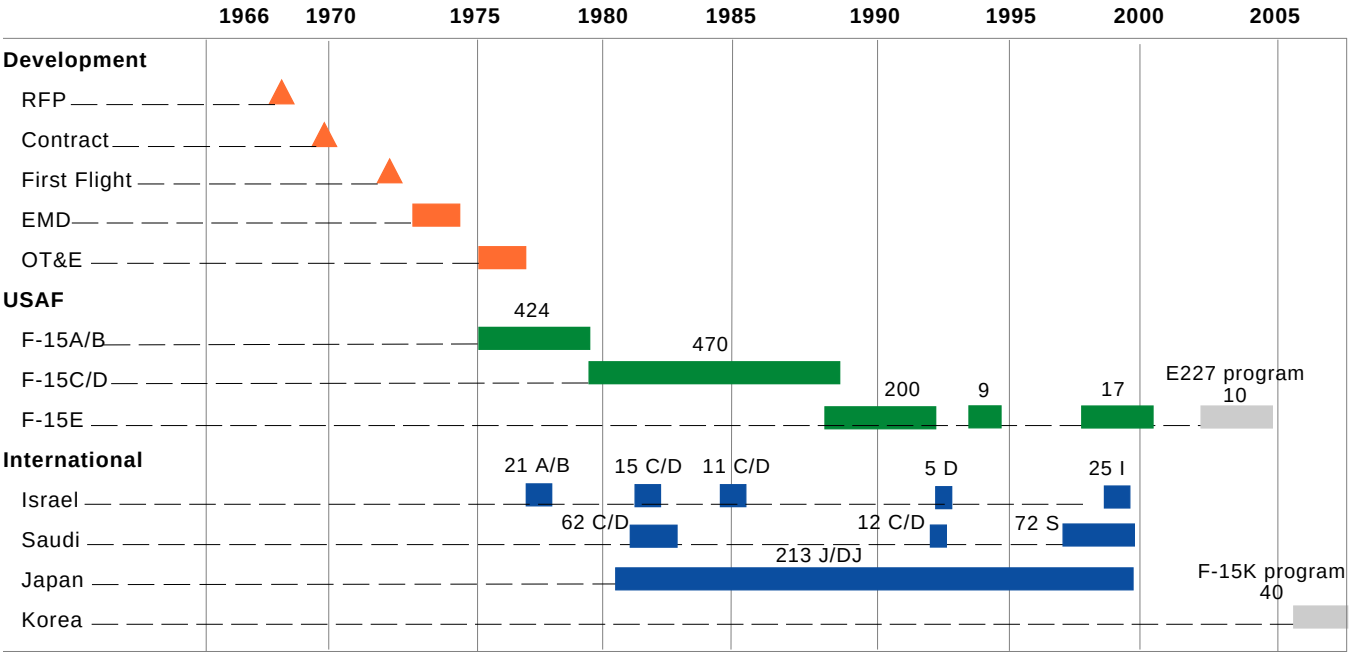
Propulsion
F110-GE-129A Engine

Crew Station
Night Vision Compatible
Electrical Interseat Sequencing

Acronyms

ADCP	Advanced Display Core Processor
DAS	Digital Altimetry System
GPS	Global Positioning System
ICS	Intercommunication System
INS	Inertial Navigation System
IRST	Infrared Search & Track
JHMCS	Joint Helmet-Mounted Cueing System
LCD	Liquid Crystal Display
RWR	Radar Warning Receiver
TACAN	Tactical Navigation

Fig. 9 **F-15 Production History**



One is Seoul's commitment to buy 40 aircraft at the same time that it is beginning the development program. The provision provides Boeing the kind of commitment it needs if it is to allocate resources needed to deliver the required capability on schedule. The management flexibility that comes from such a commitment—defined requirements, agreed configuration, stated quantities, specified price, contractual cash-flow arrangement—is significant.

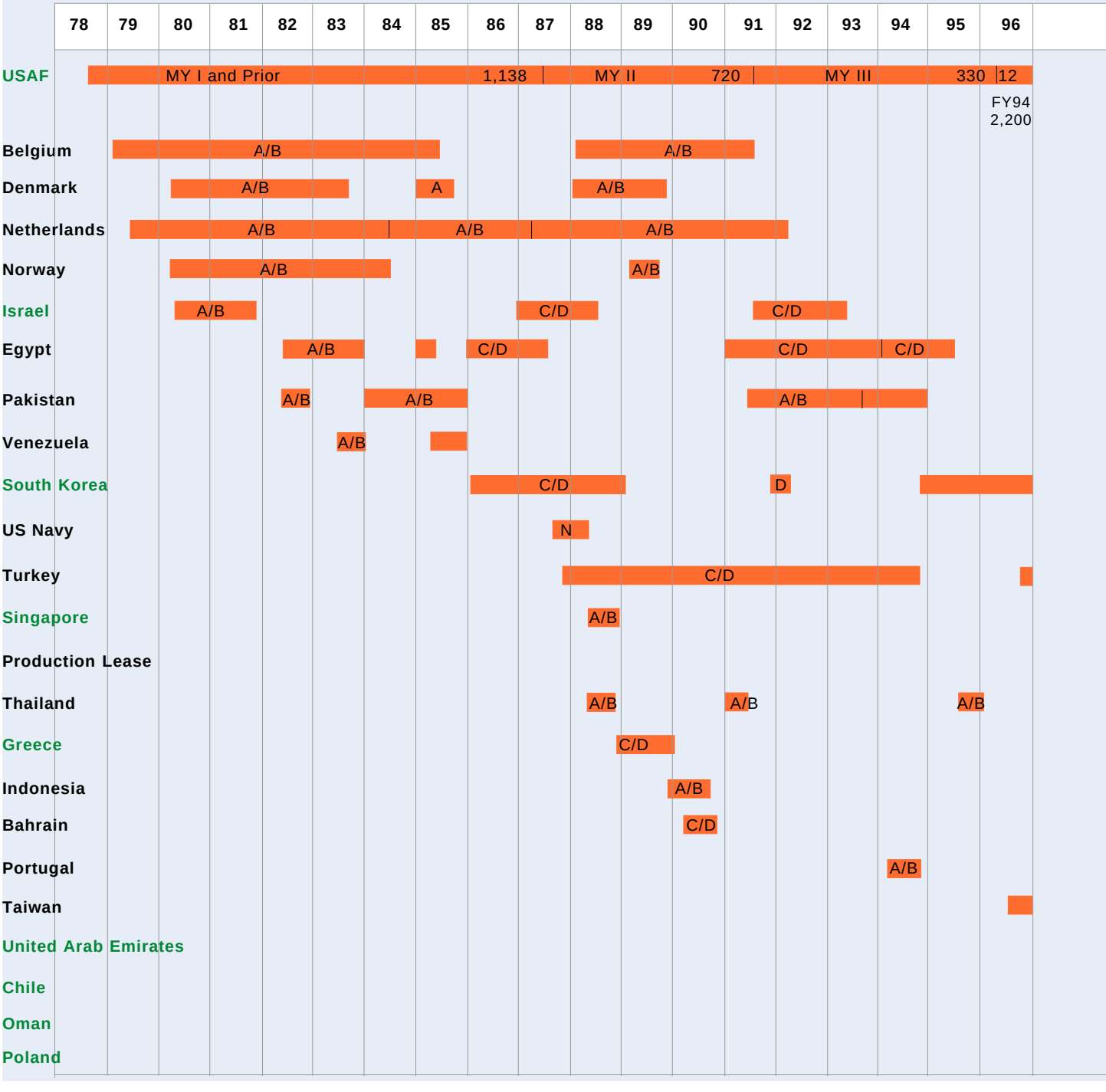
How did Boeing win the competition? I put that question to Mike Marks, Boeing's vice president/general manager, USAF fighters, bombers, and weapons. Success, he said, stemmed from four factors: price, capability, Boeing's reputation for delivering capability, and the credibility of USAF and the United States government. His point was that USAF and the US had demonstrated the ability to evolve and maintain front-line combat capability with the F-15 system. South Korea, therefore, was confident that the F-15K would be delivered on time with the required capability. Contracting for development and production efforts—together, in one contract—ensured that this would happen.

F-16, Foreign and Domestic

General Dynamics delivered to the United States Air Force the first operational F-16A (Block 1) in November 1978. Over the next 25 years, the F-16 line churned out 4,131 of these lightweight multirole fighters. They have been procured by 18 air forces around the world, with a little more than half of them going to the United States Air Force. See **Fig. 10.**

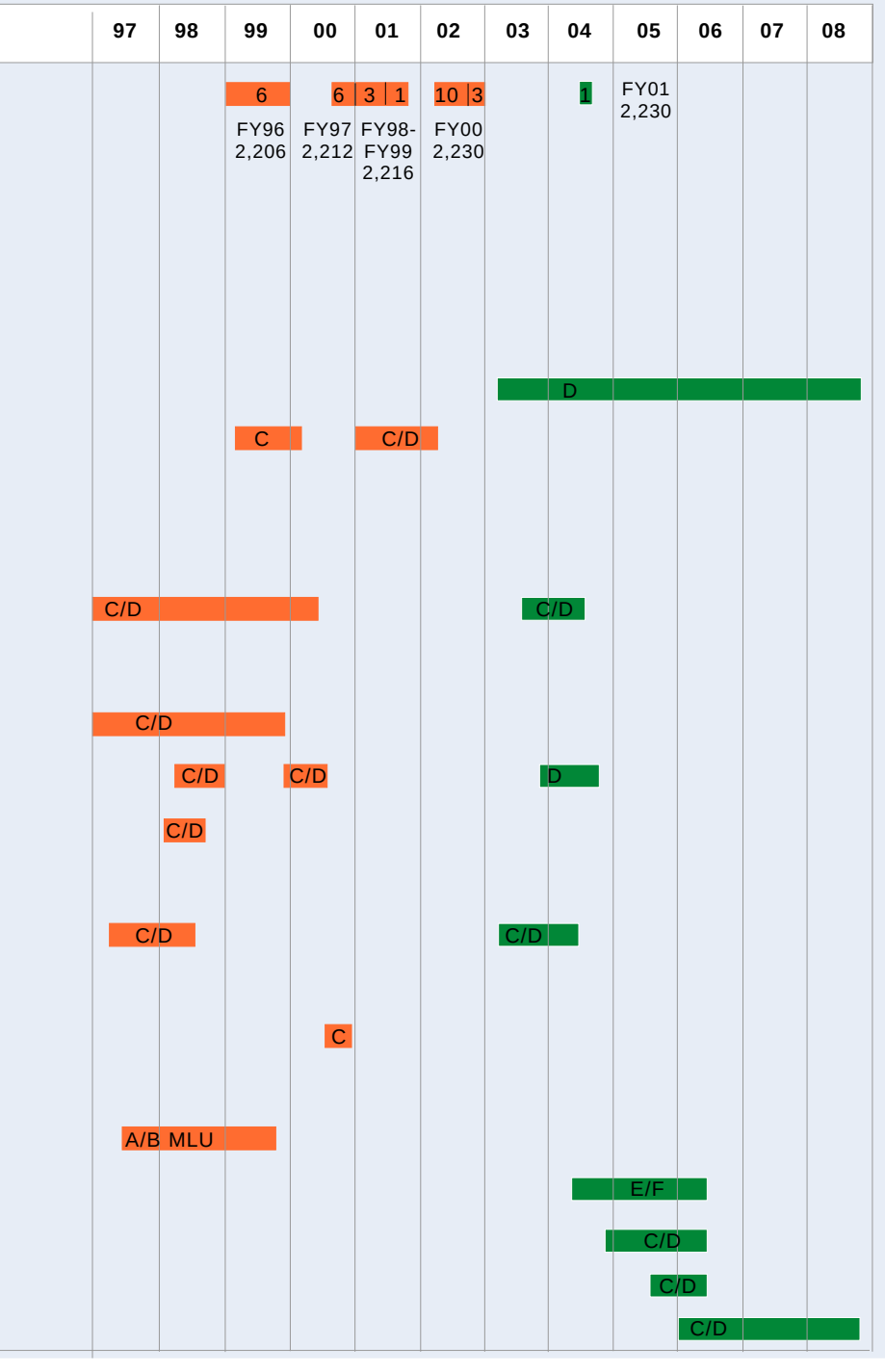
Another 286 aircraft were in various stages of manufacture as of early 2004. Some of these were foreign

Fig. 10 **Historical FMS/DCS F-16 Program Relationships**



military sales cases, but some also resulted from direct commercial sales. Indeed, the most advanced F-16 model in the world is the product of a direct commercial sale. It is the F-16 Block 60, now being developed for the United Arab Emirates.

The UAE F-16 contract was awarded to Lockheed Martin (which absorbed General Dynamics) in June 2000. It specifies the purchase of 80 F-16 aircraft. It also provides for a substantial development package that envisions integration of new technologies, some of which do



Active Production

Status	# Aircraft
Firm	4,417
Delivered	4,131
Remaining	286

As of Jan. 1, 2004
Source: Lockheed Martin

not exist in the USAF fleet and will not until the fielding of the F/A-22 and F-35. The contract also provides for the purchase of training and logistics support. The total contract value: $6.432 billion.

Lockheed Martin provided commercial warranties and committed to delivering the first operational F-16E/F aircraft to the UAE in May 2004; actual delivery occurred in June 2004. **Fig. 11** provides a summary of the aircraft capabilities.

Fig. 11

F-16E/F Block 60 Family Revolutionary Configuration Enhancements

Next generation COTS-based avionics with fiber channel
Advanced, integrated cockpit
Revolutionary AESA radar and FLIR systems
Higher thrust engine
Most advanced internal electronic warfare suite
New precision weapons
Conformal fuel tanks
600-gallon tanks
Increased takeoff gross weight
New environmental control system
New core avionics with high-speed data bus
Data link
New flight controls
Integrated navigation (GPS/INS/DTS)

The program plan for the F-16 Block 60 looks very much like the F-16A program plan of the mid-1970s. It features phasing of the development work, procurement of long-lead items for production, and delivery of operational aircraft to the UAE even before the conclusion of system integration and flight test. It would be easy to say that the F-16 is a mature aircraft and therefore the risk is acceptably low. However, a careful look at the proposed technologies, change of planform, addition of conformal fuel tanks for extended range, alteration of the cockpit arrangement, and other features would lead an experienced program manager to dispute that claim.

Even so, some critical aspects of the UAE program increase prospects for success. For example, Lockheed Martin has given its program manager total control over all aspects of his program. The entire program has been fully funded, up front, by the client government. Within the price structure, the PM has a management reserve. He also has authority to allocate or reallocate budgeted resources across the entire program; he does not have to worry about keeping separate development, production, and O&M accounts. He has a technical baseline, complete with an agreed-to test matrix and criteria for successful completion of individual test events. His primary obligation is to deliver combat capability, as specified. He has authority to make system-level trade-offs that will provide the specified performance capability. Most importantly, he has a funding stream matched to schedule, thus ensuring he will have the proper infrastructure, people, and parts.

The Block 60 aircraft had its first flight on Dec. 6, 2003. The contractor conducted 12 test flights in the first month, something achieved in few if any modern day aircraft programs.

Comparative Summary

It appears that, in the cases of South Korea's F-15K and the UAE's F-16E/F, foreign nations were able to obtain advanced air combat capability more rapidly (with an associated lower cost) than would be the case if these aircraft were developed for the United States Air Force. While there is no current direct comparative USAF program, it is worth looking at the factors, in today's world, that appear to allow foreign nations to develop and field capability so quickly.

This analysis has looked at the Defense Acquisition System, past and present; the tactical aircraft programs of the early 1970s; the management structure for USAF acquisition management and USAF foreign military sales; the legislative and DOD/USAF management "reform" actions since 1975; past F-15 and F-16 production programs in support of USAF and FMS; and direct commercial sales of F-16 Block 60 aircraft to the United Arab Emirates and the F-15K aircraft to South Korea.

A bottom line summary is as follows:

Packard's DODD 5000.1 reflected and codified an acquisition environment. Out of that environment emerged three highly capable and successful systems, all produced in relatively short periods of time in the early and mid-1970s. The acquisition system has undergone dramatic change in the past 30 years. Today, we do in fact have in development two new tactical fighters—the F/A-22 Raptor and the F-35 Joint Strike Fighter. The schedules for these two are dramatically longer than those of the aircraft produced in that earlier period. At the same time, US industry is carrying out two other fighter programs—the F-15K and the F-16E/F. Both are technologically advanced. However, because they are being built under

direct commercial sales policies, they have not been subjected to the vagaries of today's acquisition system. They are proceeding under a setup that closely approximates the system of the early and mid-1970s. And finally, they are being produced at a much faster pace.

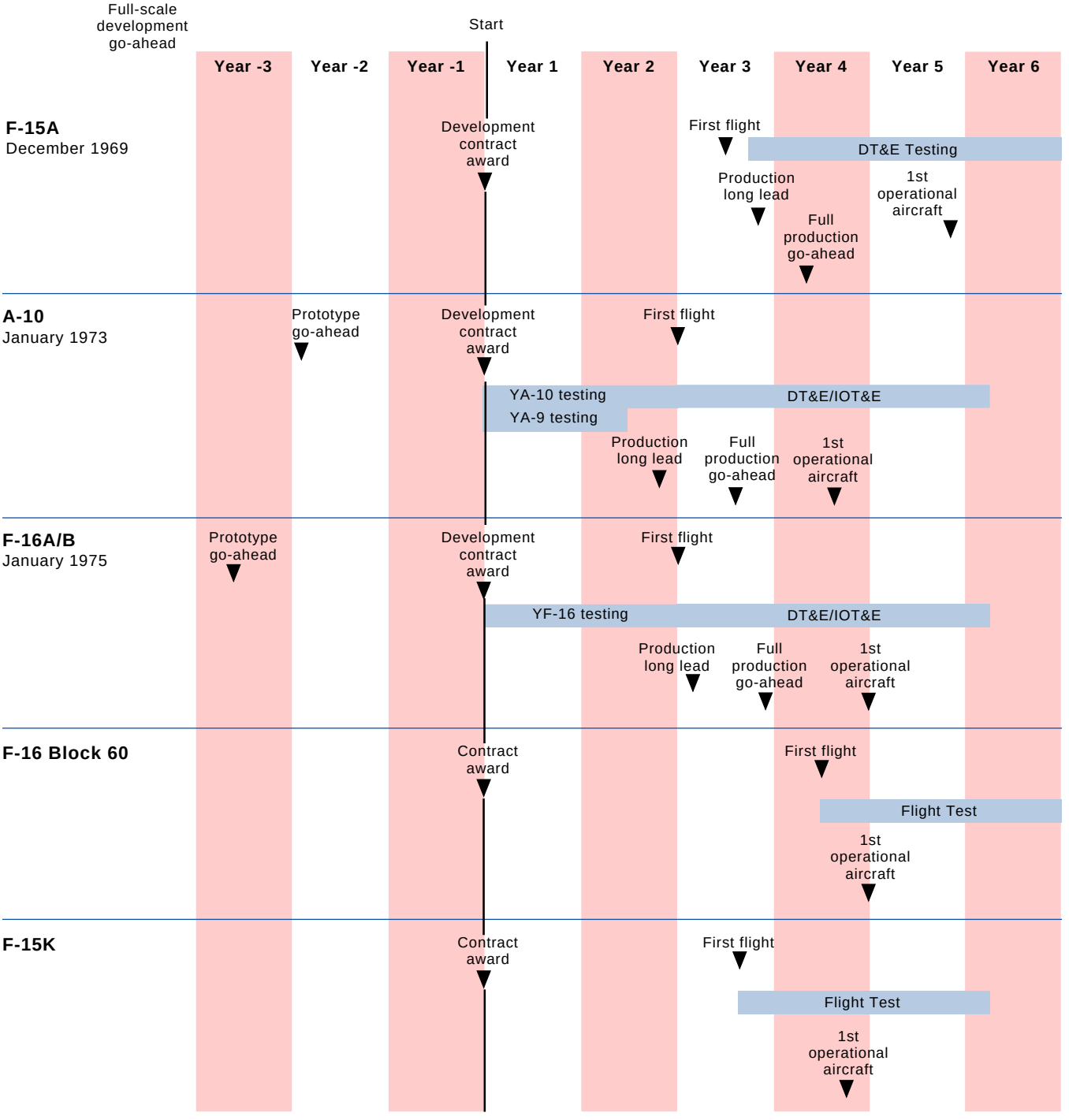
Why is this happening? The following comparisons may be helpful in answering that question. See **Fig. 12.**

First, the program plans for the F-15, A-10, and F-16, from the award of the development contract to delivery of the first operational aircraft, look remarkably like the UAE's F-16 Block 60 and South Korean F-15K program plans.

■ *System performance requirements were understood and agreed to at the time of contract award. While the*

Fig. 12

Operational Delivery Comparison



DT&E Developmental test & evaluation
IOT&E Initial operational test & evaluation

pre-contract award (requirements definition) approaches were slightly different, each program had a defined set of requirements baselined into the program plan at the beginning.

■ *Each program was or is managed by a relatively small management team with clear lines of authority, responsibility, and accountability. Day-to-day execution of the programs was or is managed at the program office level with appropriate program status reviews.*

■ *Each program plan was or is based on a management philosophy of managing risk across both development and production activities to provide usable capability at the earliest time consistent with minimizing total costs.*

■ *Few changes were allowed or incorporated into these programs (F-15A, A-10, F-16A) once development work began. Improvements were typically handled through follow-on models.*

These are the major positive attributes that contributed to the success of each of these programs. What is not present in each of these programs is an intrusive involvement by a number of staff members from either OSD or Congress or a number of requests for data to support budget drills and alternative mission capabilities once the program began development. Recall that Secretary Packard was quite clear, specifically in the case of the F-15A, and, in general, in writng DODI 5000.1, that staff involvement was not to interfere with the successful progress of the programs. That is not to say that the Air Force programs could have been successful without the support of OSD and Congress. It does, however, reinforce the fact that OSD and Congress have an important role to play in advocating and supporting programs from a strategic national capability perspective; without that support, the services cannot field needed capabilities in the most affordable manner.

Second, F-15s, A-10s, and F-16s developed in the early 1970s, as well as the F-16 Block 60 and F-15K, are all excellent examples of a "technology push" (instead of "technology pull") approach to fielding an operational capability.

■ *All entailed working early and actively with operational users to establish performance requirements consistent with emerging technologies at the time of contract award.*

■ *While the A-10 has not changed much over time, the F-15 and F-16 aircraft have both evolved as new technologies have matured. They have been integrated into each aircraft through incremental block upgrades, an approach known as "spiral development" in today's vernacular.*

■ *Sales of different models of these aircraft to foreign countries over the past 30 years, either through FMS or DCS, have repeatedly demonstrated that technology push is faster and more efficient than technology pull for fielding advanced operational capability.*

The F-117 program offers one of the best examples of technology push in the past 30 years. The Air Force did not want to pursue a low observable aircraft when the Advanced Research Projects Agency (ARPA) first proposed it in 1975. There was no requirement for a low observable aircraft. Nor was there a concept of operations (CONOPS) for using such an aircraft. Higher priority had been assigned to a number of programs—the A-10, F-15, and F-16. Yet the then-Chief of Staff, Gen. David C. Jones, saw the significant operational potential of low observable aircraft in the context of Air Force missions. He supported the ARPA initiative to conduct a demonstration program to find out if the signature of a tactical-size aircraft could in fact be reduced sufficiently to allow it to survive in a hostile environment. With the success of the Have Blue technology demonstrations, the F-117 development program was initiated in 1978—without any specific requirement or CONOPS. Both of these were developed at an appropriate time, based on the understood capabilities of the operational F-117 system. The F-117 system delivered its first operational aircraft 15 months after first flight of the first test aircraft. IOC was declared only 13 months after that first operational delivery. The Air Force went from development contract award to operations in less than five years.

Third, the acquisition process has changed considerably over the past three decades. Have those changes been consistent with the changes in DOD and the aerospace industry?

■ *Technology change in the early 1970s was slow, compared to technology change today. Yet, development of current tactical aircraft takes at least twice as long as that of aircraft in the early 1970s.*

■ *The length of development today affects configuration control, development test and evaluation, operational test and evaluation, and logistic support planning. When this is taken into account, it seems wiser to build a basic, albeit limited, capability that can be improved incrementally. In fact, this makes it more important than it was 30 years ago.*

■ *The F-16 Block 60 and the F-15K programs confirm that it is possible to build up front a baseline plan which takes advantage of commercial technology advances in the near term while planning for and executing over the long term a significant number of production aircraft. With this approach, a number of key factors can be priced out and put on contract.*

■ *The F-15A, A-10, and F-16A emerged from a thriving industrial base, one with experienced workers and strong connections to a robust Air Force development planning group at Wright-Patterson. This helped the Air Force match certain maturing technologies with future system requirements as part of predevelopment activities. This led to sound program plans.*

Additional Observations

The Defense Acquisition System of the 1970s would have to be judged a success. It produced a high level of combat capabilities in a relatively short period, infusing systems with the latest technologies. Moreover, the F-15s and F-16s of that period lent themselves to upgrading with a series of new configurations in the 1980s. It was this evolutionary process that allowed Lockheed Martin and Boeing to provide the proven combat capability that we have in today's Air Force and that we have made available to our friends and allies overseas.

I find it most interesting that there are significant common attributes between the early 1970s programs (F-15A, A-10, F-16A) and the current direct commercial sale programs (F-15K, F-16 Block 60), both of which led to quick delivery of capability.

These common attributes can be looked at within the framework of the evaluation criteria established at the start of the study:

- Mind-set or "culture"
- Leadership
- Total program perspective
- Clarity and stability of requirements
- Test and evaluation
- Stability of funding

Mind-set or "Culture"

There was an aeronautical enterprise that preceded the start of the programs in the early 1970s—one that was engaged in the identification of new capabilities consistent with emerging, maturing technologies. These technologies were the catalyst which provided the basis for determining what was possible in the near term while allowing for capability growth in the future. In the late 1960s and early 1970s, Air Force development planning experts at ASD, working with industry planners and senior government officials, were able to have viable candidates ready to fill new operational requirements in a timely manner. In the case of the DCS programs today, industry business development people played the same role in identifying those capabilities that could be fielded quickly, taking advantage of today's maturing technologies.

In addition, the Air Force laboratories in the late 1960s and early 1970s, working with their parent product division, were developing a number of technologies that could have future potential, without worrying about specific operational concepts and specific weapon system applications. At the same time, the product divisions, working through the development planning auspices, were acutely aware of industry independent research and development (IR&D) activities. In many cases, there were also manufacturing technology (ManTech) initiatives being pursued within industry under the Air Force's ManTech program. All of the efforts were mindful of the long-term future program perspectives and the need to bring to maturity the technologies that would allow development programs to proceed at an appropriate pace with manageable risk once initiated. These same kinds of activities, although fewer in number and more focused on specific weapon systems, are also part of industry activities leading up to a direct commercial sale to a foreign government.

Leadership

Air Force and Pentagon leadership created an environment for the execution of the F-15A, A-10, and F-16A programs that encouraged the program directors to take charge of their programs, to be the leader of the program team (including the contractor and supporting government agencies). This included clear direction on roles and responsibilities of all of the program participants and identifying who had authority for making programmatic decisions and who would assist as staff "advisors." While not specifically written down anywhere (other than in the original DODD 5000.1), the leadership of the Air Force established the environment through their operational relationship with the program directors of each program, respecting their abilities and authorities to make the right long-term decisions for the Air Force, consistent with program priorities, while also holding them accountable. Close examination of the F-15K and F-16 Block 60 DCS programs shows the same environment today—a single program manager responsible for making the right programmatic decisions, consistent with the best long-term direction of the program and the future operational capability of his respective systems.

Total Program Perspective

The F-15A and F-16A programs both demonstrated that we can develop and field capability quickly if we focus on developing capability that is consistent with relatively mature technologies and leave the immature "advanced" technologies to follow-on models utilizing the spiral development approach. The A-10 was never envisioned to be anything other than a sound close air support aircraft. Air Force officials therefore made their decisions within the context of delivering that fundamental capability quickly. The F-15 and F-16 programs have both demonstrated over the years the principle of building a capable platform and then adapting the subsystems to fit the mission needs and the operator's desires. This has been consistently demonstrated in numerous FMS programs as well as in newer, more-advanced models for USAF over the past 30 years. This same perspective applies to the current DCS programs at both contractors. Both have fully integrated programs that provide not only new advanced capability but also provide for the necessary testing, training, and support to make the systems operationally effective once delivered to the foreign air forces. In the case of the DCS programs, the task of identifying and agreeing to all of the program requirements up front was made easier by the amount of proven technology existing at the start of the programs. However, this also demonstrates the principle of clearly

identifying the scope up front, then sticking with it, incorporating new requirements in future new efforts.

Clarity and Stability of Requirements

As has been mentioned above, the existence of the aeronautical enterprise in the late 1960s allowed for a good understanding of executable program requirements that would lead to satisfying a set of USAF operational performance requirements. The business development activities preceding the start of the DCS programs accomplished the same thing for the foreign countries. The most interesting conclusion that one can draw from this is: Establishing and limiting one's self to a manageable set of technologies and capabilities does allow for quicker fielding of operational capability once the development work begins. It also has been demonstrated over the years that it is possible to establish new requirements which can be addressed through new technologies at the appropriate point in time.

Test and Evaluation (T&E)

The task of proving the capability of a weapon system, prior to actually using it in combat, falls to the test and evaluation process. All five programs (F-15A, A-10, F-16A, F-15K, F-16 Block 60) had/have a high degree of concurrency between development, primary systems integration, and production. I would observe that, by limiting technology incorporation to relatively mature technology, one is able to better establish the necessary test criteria at the start of the program. This not only contributes to providing the right system performance but also establishes common expectations for success, increasing the probability of success for both the system and the program. In these five programs, the T&E activities played/play a critical function of identifying and, in many cases, resolving system deficiencies early in the development cycle. The A-10 program clearly demonstrated that the T&E community could contribute to the success of the program by being a team player as well as an objective evaluator of performance. I would suspect that the T&E community would play a similar role in the current DCS programs.

Stability of Funding

In addition to the characteristics of the five programs of interest already discussed, the level of stability of the necessary funding for development has to be considered a major contributor to the success of the early development programs and will be a major contributor to resolving any issues that surface in the DCS programs. My judgment is that it is nearly impossible to measure the direct impact on a program associated with year-to-year funding cuts because of the dynamics that occur on highly integrated systems and programs when one tries to remove selective pieces without an adequate systems engineering analysis. However, I think it is relatively easy to see the benefits of maintaining funding stability. One only has to look at what happens to weapon system prices when the government commits to multiyear contracts with associated funding profiles. The C-17 program restructure that occurred in the 1994-95 time frame is a clear example.

With regard to FMS funding stability, former Air Force Security Assistance Center commander Brig. Gen. Jeffrey R. Riemer recently reminded me of the management flexibility delegated to him:

> *In addition to stable requirements and funding, the other difference between US and FMS program management was my ability on FMS programs to reprogram dollars within a country's portfolio. With customer approval, which is normally achieved very quickly, I was able to move dollars from one case to another to maximize efficient use of the country's money.*
>
> *In our US system, PEOs have similar groupings of portfolios, but, with Congressional restrictions on reprogramming between and within appropriations, it ties their hands in being able to quickly reprogram dollars. It also puts those dollars in jeopardy, which, in turn, generates delays and scrap and rework if the funds are lost.*
>
> *As an FMS program manager, I had a stable requirement, stable funding, the ability to move funding to where it was needed to produce the requested capability on cost and on time, and, once the decision to buy a given quantity of a system was decided, the development and production portions of the program were executed as planned. This allows the government industry team to focus on program execution rather than the numerous what-if-drills associated with our US programs.*

Recommendations

Those of us who have operated within this acquisition system over the past three decades know that it has cycles, moving in one or another direction according to external pressure and demands. All signs are that we are now at one of those points in the cycle when we need to change course. We need to go back to the future in order to do a better job of delivering future generations of aircraft.

This paper has attempted to look at those tactical aircraft programs of the last 35 years that have delivered combat capability quickly, once the development program was approved, directed, and funded. The historical data from the F-15A, A-10, and F-16A programs developed in the early 1970s and the current data from the F-15K and F-16 Block 60 direct commercial sale

programs would say that there are four fundamental program characteristics that contributed directly to the speed of delivery.

■ *USAF developed a thorough pre-system acquisition activity in which technology, operational concepts, and system performance requirements were clearly established and agreed to. This activity involved the developer (USAF in the early 1970s and the contractor for DCS programs) and the operational user. This usually resulted in the best understanding of what was needed to achieve the necessary capability and was doable in the quickest amount of time, as well as what could be fielded with follow-on versions of the basic capability. In this case, that meant subsequent models of the same airframe.*

■ *Once the development program was approved and initiated, changes were kept to a minimum to allow for early fielding of the basic capability while future capabilities and technologies were built into the program plans for future versions of the basic system. The F-15 and F-16 certainly establish the precedent for this approach. Each started with a solid airframe design, tailored to that portion of the operational requirement (and flight charteristics associated with those requirements) for whch it was being developed. Both airframes facilitated the growth in capabilities because of the flexibility and soundness of the airframe design. It takes discipline to develop the basic capability and then grow the increased capability, but it can be done as part of a well-thought-out pre-system acquisition planning activity.*

■ *The programs were/are managed with a small management team, and the data and reporting requirements were/are minimized. This involved delegating the decision-making authority (and responsibility) to the program director and his program office team and relying on them to make the proper management decisions consistent wih the program direction and priorities. At the same time, their reporting requirements were limited to only major program issues or threshold breaches. The data from the F-15A/A-10/F-16A would suggest that it is absolutely essential to reduce the number of people involved in the day-to-day execution of the development program to only those individuals within the program office who have been charged with the responsibility of managing the program. This is further demonstrated in the structure of the relatively small contractor teams at both Boeing (F-15K) and Lockheed Martin (F-16, Block 60).*

■ *Program management teams were provided the planned resources, as well as the authority and responsibility, to execute the program as planned. This may be the most important consideration in achieving timely completion of the development phase of the program. In each of the cited USAF programs from the early 1970s and DCS programs of today, the funding commitments—by Congress in the USAF case and foreign countries in the DCS case—supported not only the development activities but also allowed for early production ramp-up, program efficencies, and reduced total program costs.*

The challenge is to take these characteristics and use them to rethink the current acquisition system with the objective of developing and fielding combat capability, utilizing the proven spiral development approach that was so clearly demonstrated on the F-15 and F-16 programs from the early 1970s through today.

I would suggest that we use Packard's DODD 5000.1 of 1971 as a starting point, given that this document was the basis of the system that has governed major acquisitions for the past three decades. This DODD established three major considerations to determine if the DAS was operating successfully—the mode of operations, the conduct of the program, and the shape of the program. They are as valid today as they were then.

Marvin R. Sambur, assistant secretary of the Air Force for acquisition, has made organizational and policy changes that could set the stage for such a change. The restoration of program executive officer responsibilities and authorities at the product center commander level is a significant step toward a return to the operating model of the early 1970s. Creation of "enterprises" such as the aeronautical enterprise at Wright-Patterson begins to address capability issues affecting future air combat capability. With the PEO serving as the enterprise commander, he now has the ability to conduct development planning as it was done in the early 1970s, formulating alternatives that can be considered early in the requirements phase. Sambur's initiatives on technology transition, collaborative requirements, and seamless verification are essential to constructing a more agile and responsive acquisition system.

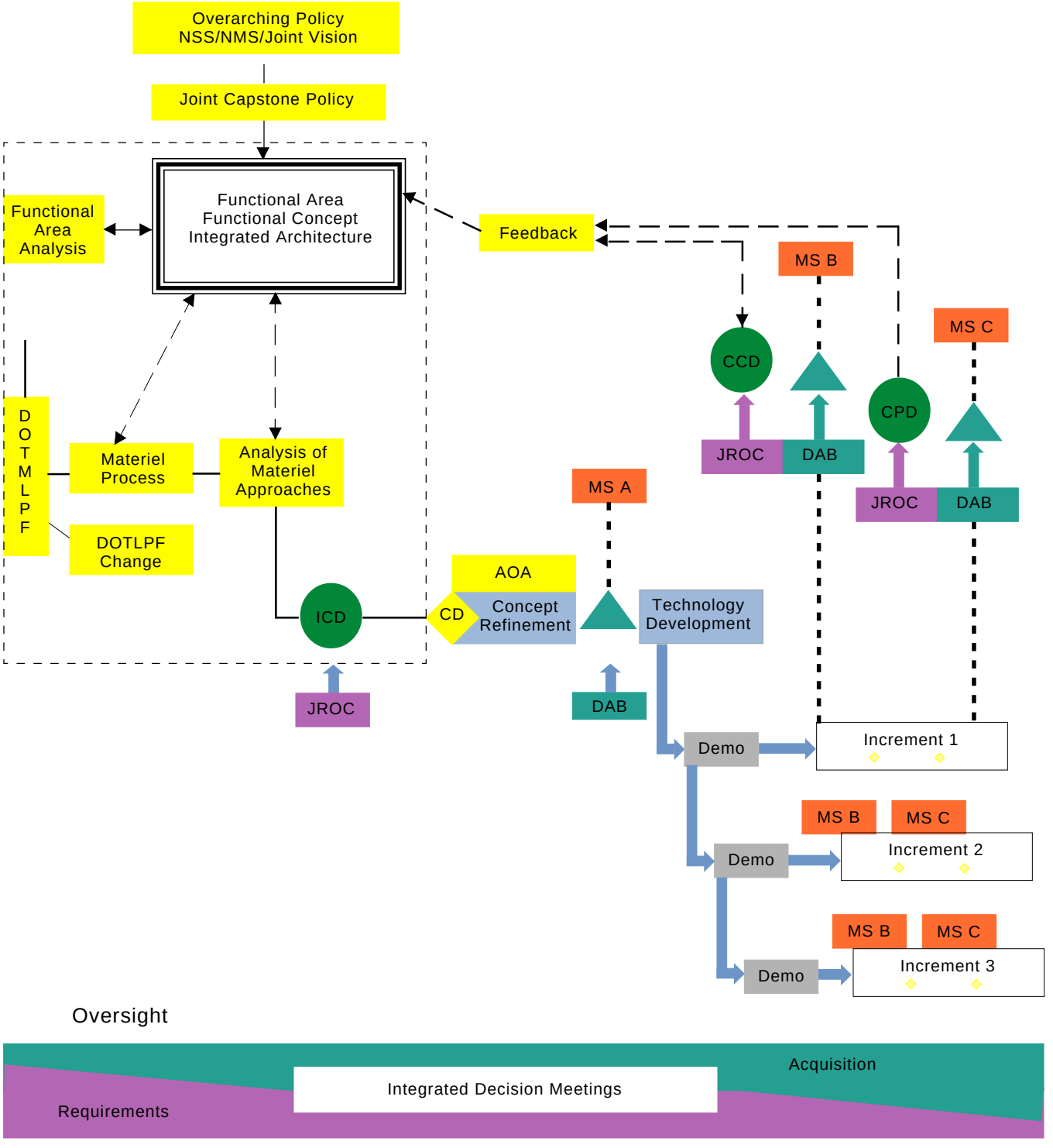
However, there is a need to take additional major steps if the acquisition system is to be made to work the way it did for USAF in the early 1970s (and in the FMS and DCS cases of the past 30 years). That major step, as I see it, is to separate the Defense Acquisition System from the requirements generation system, though the two can be integrated within the Planning, Programming, Budgeting, and Execution (PPBE) process.

Let me suggest a possible framework.

The Defense Acquisition System is shown in **Fig. 13** (p. 34), as extracted from DODI 5000.2. However, it's not easy to tell where acquisition starts and requirements stop, especially when the oversight bar at the bottom shows requirements can continually work their way into a program long after the start of the acquisition process. The fact that there are "integrated decision meetings" going on after Milestone B is not consistent with the approach identified in Packard's original system or with the operating model of the F-15, A-10, and F-16 programs.

Some would say that the chart was only intended to convey the message that requirements come first and can evolve as new technologies and concepts evolve, and that those requirements would be approved for incorporation in future increments. In other words, it is not a technically accurate description of the situation. We can, and should, make it technically accurate and, at the same

Fig. 13 **Requirements and Acquisition Process**



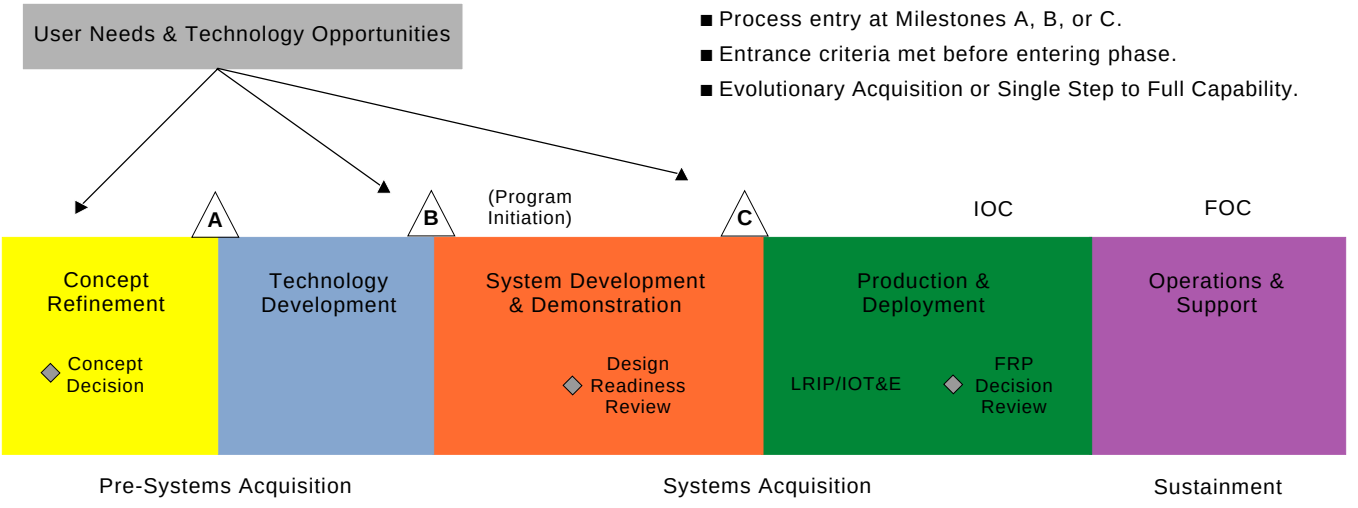
time, discipline the process so the system can respond more quickly once a decision to proceed has been made at Milestone B.

The fact that DODI 5000.2 also contains a chart showing User Needs & Technology Opportunities occurring post-Milestone B does in fact convey the wrong message regarding changing the program after the start of development. See **Fig. 14.** I would submit that a close examination of other ongoing tactical aircraft development programs would demonstrate that incorporating requirements based on immature technologies has in fact contributed to the delay in the basic combat capabilities that these newer aircraft would bring to the fight.

Judging from the cases of the Air Force's F-15, A-10, and F-16 programs and the cases of the South Korean F-15K and UAE F-16E/F, the requirements and acquisi-

Fig. 14 The Defense Acquisition Management Framework

DODI 500.2, May 2003



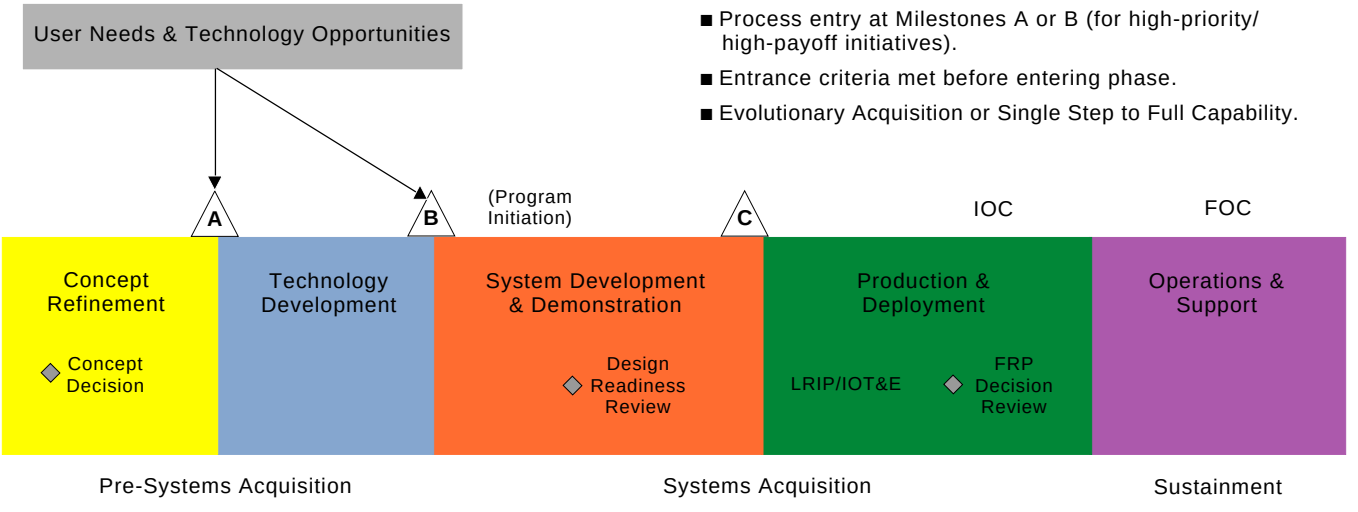
tion process has two basic parts—a pre-system acquisition phase and an acquisition and sustainment phase. This fundamental construct would not be inconsistent with the current DODI 5000.2 as shown in **Fig. 15.** What would be different, given the data on the programs mentioned above, is the implication of inserting (or not inserting) new requirements after Milestone B. This approach would be more consistent with a true spiral development approach to evolving capability in subsequent models.

Once we recognize that certain pre-acquisition activities are essential to determining the program baseline, we can identify key stakeholders. We can also identify their roles and responsibilities. It is essential to incorporate the Joint Capabilities Integration and Development System (JCIDS) perspective (as seen by the Joint Requirements Oversight Council and the OSD staff), concept refinements (as seen by the Air Force), and technology development initiatives (within Air Force Research Laboratory). These factors could support achievement of the required capability in a future system acquisition program.

We need to establish a clear set of service requirements that support joint capabilities and a relevant Air Force concept of operations. These should be based on, and consistent with, Air Force Research Laboratory roadmaps. There needs to be an increase in the amount of technology push, as there was with the stealth aircraft. Technol-

Fig. 15 A Defense Acquisition Management Framework

(Recommended)



ogy still has a role to play in maturing improvements for use within existing forces and CONOPS, but the high payoff capabilities can only come from a revolutionary technology…leading to yet-unthought-of CONOPS and requirements. These approaches would provide a sound basis for identifying technical and operational needs and for building a realistic program schedule and funding estimate. This activity would help us incorporate a proper set of expectations into the program management directive and the test and evaluation master plan. This would help provide feedback to the requirements generation system as the program progresses.

In my judgment, the key stakeholders in this pre-system acquisition phase are in two basic groups. One is the group that carries out integrating IPT and overarching IPT activities on existing programs. The other comprises the staffs of the HQ USAF and operating MAJCOM staffs that deal with future Air Force capabilities and requirements and are now involved in the day-to-day execution of the acquisition programs.

Their value, in my judgment, has been greatly diminished. They don't get to fully influence requirements early enough in the life of the program—before the configuration, technical, and performance baselines are put on contract. The financial costs and schedule costs turn out to be much higher than they would be if the capability were incorporated as part of an integrated package within a new configuration, technical, and performance baseline. The true value of the evolutionary acquisition process is that it allows you to avoid these costs. Industry has no difficulty moving the pre-contract business development people out of the program and replacing them with people qualified to execute the program. This takes full advantage of different skill sets at different points in the program life cycle.

This brings us to the most significant (and controversial) recommendation—to separate the acquisition system from the requirements generation system, but integrate them within the PPBE system. Once you declare those activities leading up to Milestone B to be part of the requirements generation system, the next logical step is to redefine the acquisition and sustainment system as those activities managed and implemented through the service acquisition executive, program executive officers, and program offices in Air Force Materiel Command. See **Fig. 16.**

This chain of command, and the authorities and responsibilities that go with it, would then be accountable for executing the programs within their baselines. This is not a totally radical idea when you consider that the Air Force exercises this management principle in all of its operational commands. The planning function is central-

Fig. 16 **A Recommended Acquisition Management Framework**

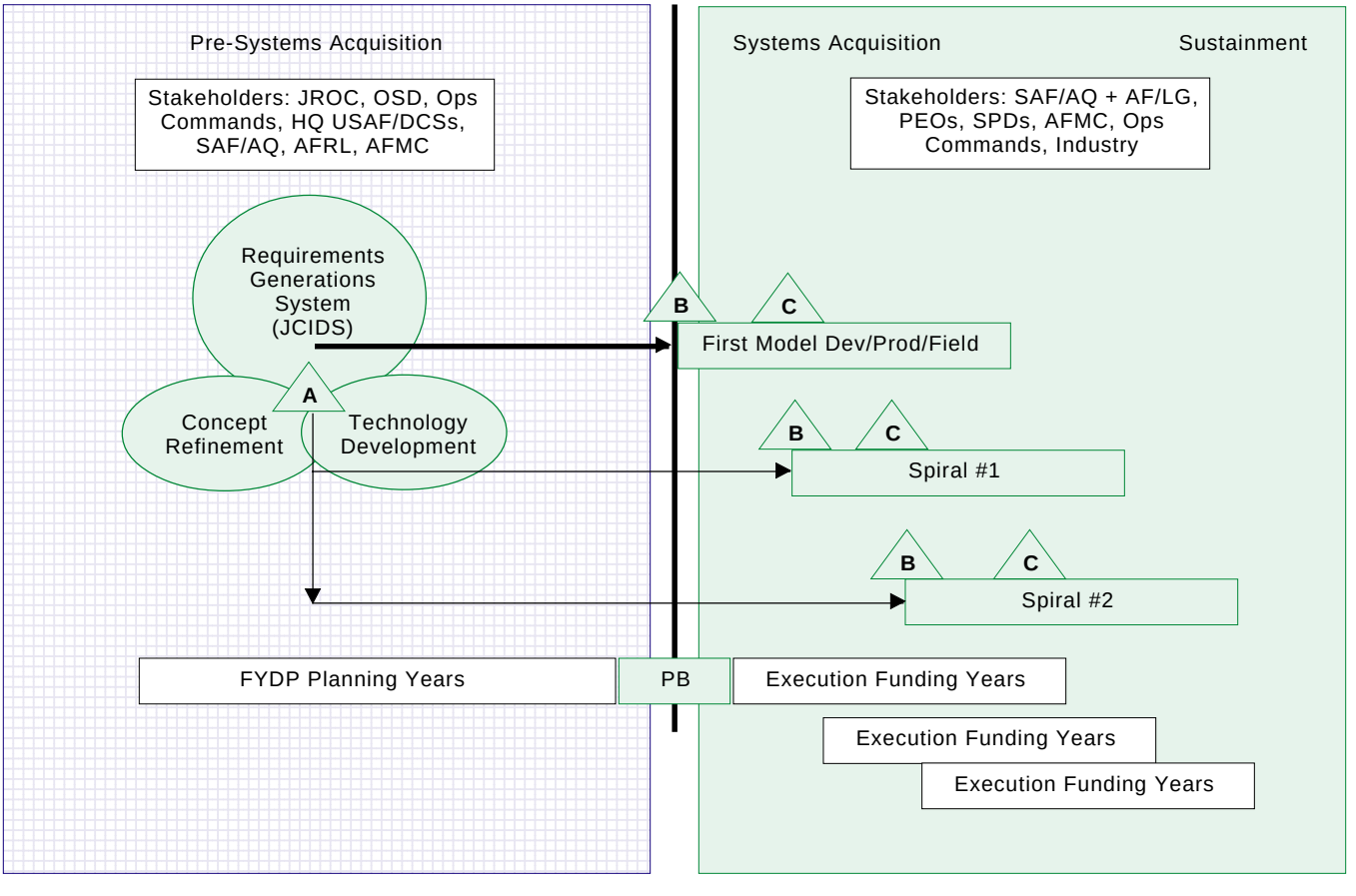
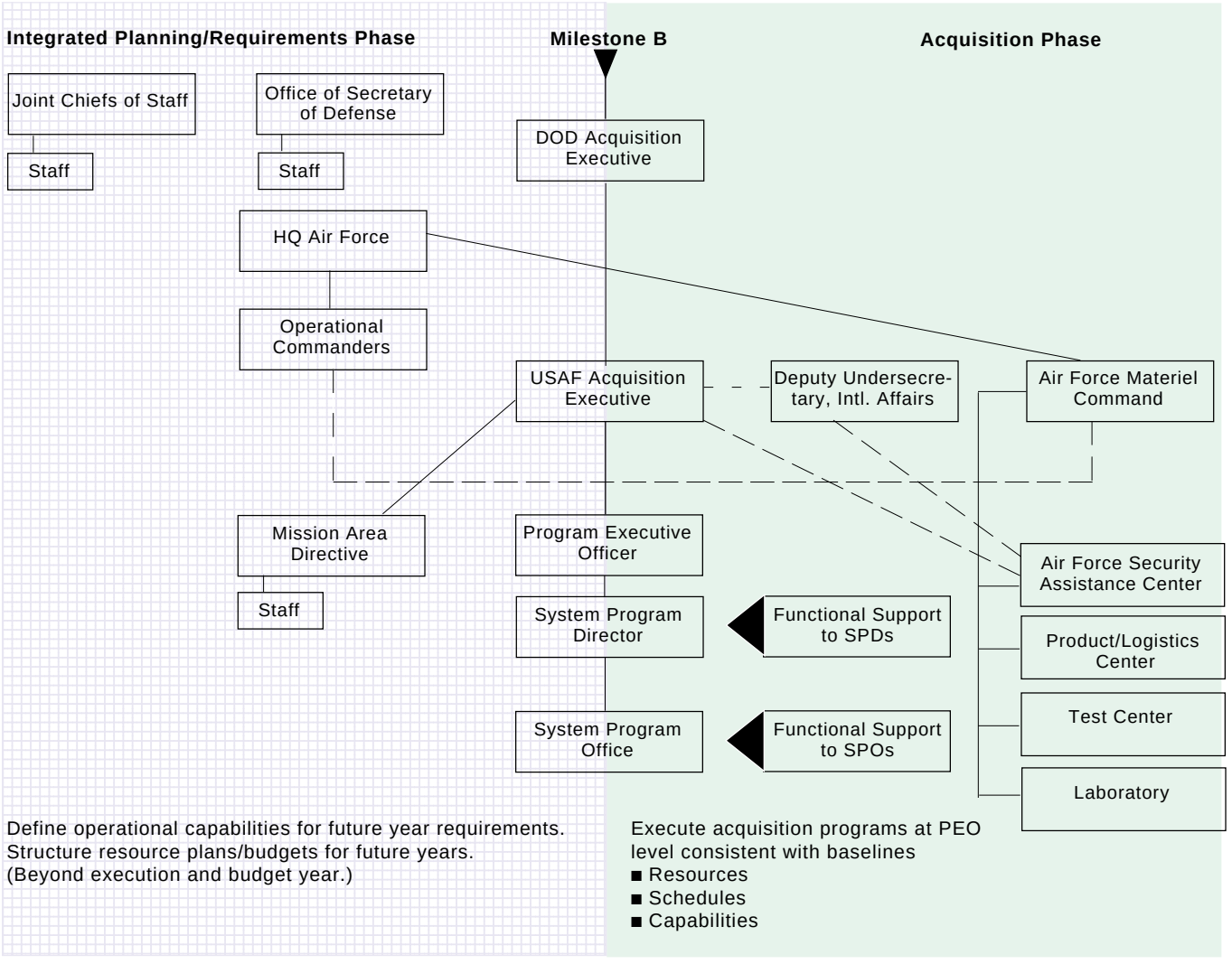


Fig. 17 **Proposed Approach**



ized within the requirements generation system in the Pentagon and the execution functions are decentralized at the acquisition and sustainment field locations. A simplified depiction is shown in **Fig. 17.**

The key to success in this recommended operating model is the resultant separation in roles and responsibilities for the two separate, but integrated, phases—the pre-system acquisition phase and the acquisition and sustainment phase. My view is that by strengthening the iterative activities between the strategic force planners in the JCS and OSD with the Air Force operators and the AFRL technologists, DOD and the Air Force are in a much better position to structure development programs that can be executed quickly. At the same time, follow-on capabilities can be folded into follow-on development spirals through the biannual budgeting process.

The histories of the F-15, A-10, and F-16 programs affirm that this is an executable approach. However, actually carrying it out would require a return to the acquisition system model that existed in the early 1970s, to include returning the appropriate level of responsibility and authority to the component heads to allow the services to determine how they will best satisfy the operational commitments in support of the national strategy. This would require that both Congress and OSD reduce their level of involvement in the day-to-day program decision-making and focus more on the strategic and policy perspective as was evident in the early 1970s and is evident in the current DCS and FMS programs. This may not be as difficult as it at first may look.

The PEOs now are enterprise commanders within the mission area product centers. This fact alone offers an exceptional opportunity for USAF to better manage a portfolio of programs within a mission area, making the appropriate trades between current and future program decisions in order to achieve a balanced capability in meeting both the near-term requirements while investing

in future technology for follow-on enhancements. That would allow the acquisition community to meet operational needs in a more effective and efficient way. Each PEO would have, or at least should have, the responsibility and authority for managing his portfolio of programs in a way that provides the necessary type of capability essential to his Air Force mission area. The PEO should be given the responsibility and resources to balance personnel and infrastructure allocations across programs.

In addition, it would be wise, and consistent with sound management principles, to give these PEOs the ability to manage funds across all programs, in line with operating command priorities, to make program adjustments as needed. This would be consistent with the approaches used in FMS program management over the years and now being used for the F-15K and F-16 Block 60 programs. They have certainly been successful.

The bottom line summary of the 30-plus years of acquisition management history discussed in this study is as follows:

■ The acquisition environment created by Packard in the 1970-71 time frame resulted in the timely development of effective tactical combat capability by the Air Force acquisition management system, with the involvement and support of its own operational and test orgnizations.

■ OSD and Congress played effective roles in supporting the programs without getting into the day-to-day decision-making of program execution by making timely decisions regarding production go-ahead, in spite of the apparent risks, and by authorizing and appropriating the necessary funding to support the program plans.

■ Over time, due to various forms of policy revisions by OSD and legislation by the Congress, a number of people have inserted themselve into the day-to-day execution of ongoing development programs. This increased involvement by additional people not directly responsible for the execution of the program would appear to be a significant contributing factor, based on the current F-22 and F-35 program development spans, to impacting the service's ability to field combat capability in a timely manner.

■ The fact that current direct commercial sale programs for advanced tactical air combat capability to foreign countries are being implemented in much shorter timelines, without the benefit (or burden) of this additional outside involvement, would tend to reinforce the argument that the acquisition environment of the early 1970s probably had it right. It is worth noting at this point that the Packard Commission in 1986 and the Defense Management Review in 1989 both came to this same conclusion and recommended that DOD (and Congress) needed to return to the operating model that Packard had originally put in place.

We may have gone full cycle. Claude Witze wrote in 1971 in *Air Force* Magazine, at the time of the Packard changes to the then acquisition system: "There is considerable irony in the fact that much of what David Packard, Mr. Laird's deputy, has called the procurement 'mess' grew out of reactions to congressional criticisms. It is not many months ago that a record number of amendments were offered to the Fiscal 1971 Defense Appropriations Bill in the Senate. Some of them came from Mr. Proxmire himself. He did not succeed in his fix-it-quick efforts, but such outbursts are mainly responsible for the fact that our govenment procurement regulations today are an impossible conglomeration of patched-up laws and directives. Aside from lawyers, who make a good portion of their living out of this regulatory jungle, almost nobody pays any attention to the basic situation. The adversary atmosphere is built into the system."[25]

It is time to go back to the future. ■

Three Strikes of the Lightning Bolts

In May 1995, Darleen A. Druyun, principal deputy assistant secretary of the Air Force for acquisition and management, announced several initiatives to reform the Air Force's acquisition and sustainment processes toward a faster, better, cheaper way of conducting business.

On April 23, 1999, the Air Force announced a new set of Lightning Bolts designed to re-energize acquisition and sustainment reform activities.

In 2002, the Air Force released Lightning Bolts 3. Together, the six new measures represented a push for "agile acquisition," the ability to deliver new capability to the warfighter as quickly as possible and at the cost promised.

1995 Lightning Bolts

1. RFP Support Team—establish a centralized RFP support team to scrub all RFPs, contract options, and contract modifications more than $10 million.
2. Standing Senior Level Acquisition Strategy Panel—create a standing Acquisition Strategy Panel composed of senior level acquisition personnel from SAF/AQ, AFMC, and the user.
3. SPO "Slim Fast" Plan—develop a new SPO manpower model that uses the tenets established in the management of classified and special access required level programs.
4. Center Acquisition Supplements—cancel all Air Force Materiel Command center-level acquisition policies by Dec. 1, 1995.
5. Integrated Process Teams—reinvent the AFSARC process through Integrated Process Teams.
6. Elevate Past Performance—enhance the role of past performance in source selections.
7. Single Acquisition Management Plans—replace acquisition documents with the Single Acquisition Management Plan.
8. Metrics to Check Acquisition Reform Progress—revise the PEO and designated acquisition commander (DAC) portfolio review to add a section that deals specifically with acquisition reform.
9. Training—enhance our acquisition workforce with a comprehensive education and training program that integrates acquisition reform initiatives.
10. Cycle Times—reduce time from requirement definition to contract award.
11. Laboratories—enhance the capabilities of our laboratories by adopting improved business processes learned from our weapon system acquisition reform efforts.

1999 Lightning Bolts

1. Acquisition Support Teams—expand the role of Acquisition Support Teams.
2. Superior Source Selections—improve all Air Force source selections by identifying expert advisors at each AFMC center and at each operational Majcom HQ/LGC that will actively participate in or advise source selections.
3. Market Analysis and Pricing Centers of Expertise—create multifunctional Centers of Expertise (COE) at each product and logistics center to gather, organize, analyze, and maintain information on market products, practices, technologies, standards, and companies.
4. Alternative Dispute Resolution—use ADR techniques to constructively address contract issues and avoid the need for litigation.
5. AEF Contracting Support—restructure operational contracting squadrons to better support wing customers and drive positive mission support, constructive organizational behavior, and the innovation of agile contingency contracting teams.
6. Improved Payment Processes—streamline the structure of accounting data, expand use of purchase cards as a payment vehicle, improve payment prevalidation process, and apply consistent payment instructions.
7. Product Support Partnerships—integrate and benefit from the mutual strengths of government depots and private industry to enhance product support to the warfighter.

2002 Lightning Bolts

1. Focus on Results, Not Process—review all acquisition requirements, in a clean-sheet paper approach, for everything the Air Force controls.
2. Spirals: Success in Increments—make spiral development the way we do business.
3. Roadblock Busters—establish a center of excellence to provide acquisition support services that focus on products produced with just the right experts, right time, and decisive numbers.
4. Create and Develop Innovators—refresh and sustain the acquisition workforce with education that instills innovation and new business practices.
5. PEO for Services Contracts—establish a new program executive office to review and administer performance-based services acquisition.
6. Knowledge Pipeline—tap into the potential of private industry to help the Air Force solve acquisition problems.

Footnotes

1. Witze, Claude, "Airpower in the News," *Air Force* Magazine, January 1972, p. 10.
2. Witze, January 1972, p. 10.
3. Witze, Claude, "In Procurement, The New Look Looks Old," *Air Force* Magazine, January 1971, p. 42.
4. Department of Defense Instruction 5000.2 (Encl 1), Jan. 21, 1975.
5. DODI 5000.2, Jan. 21, 1975.
6. DODI 5000.2, Jan. 21, 1975.
7. Rothman, M.B., RAND Note, October 1987, p. 61.
8. Fowler, Bert, e-mail note to author, October 2003.
9. Lockwood, Lyle, interview with author, April 2004.
10. Smith, G.K., *et al*, "The Use of Prototypes in Weapon System Development," RAND, March 1981, p. 62.
11. Smith, p. 45.
12. Smith, p. 45.
13. Smith, p. 44-83.
14. Smith, p. 85.
15. Smith, p. 85-86.
16. Smith, p. 86.
17. Smith, p. 86-87.
18. Smith, p. 88.
19. Smith, p. 88.
20. Smith, p. 96.
21. Smith, p. 118.
22. Department of Defense Directive 5000.1, July 13, 1971.
23. Department of Defense, "Report of the Defense Management Review," July 1989.
24. Druyun, Darleen, US Air Force "Lightning Bolt #3," May 1995
25. Witze, January 1971, p. 42.

ACRONYMS

ADCP	Advanced Display Core Processor
AESA	Active Electronically Scanned Array
AFMC	Air Force Materiel Command
AFRL	Air Force Research Laboratory
AFSC	Air Force Systems Command
AFTEC	Air Force Technology and Engineering Center
AOA	Analysis of Alternatives
ARPA	Advanced Research Projects Agency
ASD	Aeronautical Systems Division
ATB	Advanced Technology Bomber
AWACS	Airborne Warning and Control System
CD	Concept Decision
CDD	Capability Development Document
CEO	Chief Executive Officer
CONOPS	Concept of Operations
COTS	Commercial Off the Shelf
CPD	Capability Production Document
CPIF	Cost Plus Incentive Fee
DAB	Defense Advisory Board
DAC	Designated Acquisition Commander
DAS	Defense Acquisition System
DAS	Digital Altimetry System
DCP	Development Concept Paper
DCP	Decision Coordinating Paper
DCS	Deputy Chiefs of Staff
DCS	Direct Commercial Sales
DDR&E	Director of Defense Research and Engineering
DMR	Defense Management Review
DOTLPF	Doctrine, Organization, Training, Leadership, Personnel, Facilities
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities
DSARC	Defense System Acquisition Review Council
DT&E	Developmental Test and Evaluation
DTS	Data Transfer System
EMD	Engineering and Manufacturing Development
FLIR	Forward Looking Infrared
FMS	Foreign Military Sales
FOC	Full Operational Capability
FRP	Full-Rate Production
FSD	Full-Scale Development
FYDP	Future Years Defense Program
GPS	Global Positioning System
ICD	Initial Capabilities Document
ICS	Intercommunication System
ILC	International Logistics Center
INS	Inertial Navigation System
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
IPT	Integrated Product Team
IR&D	Independent Research and Development
IRST	Infrared Search and Track
JCIDS	Joint Capabilities Integration and Development System
JHMCS	Joint Helmet-Mounted Cueing System
JROC	Joint Requirements Oversight Council
KPP	Critical Performance Parameter
LCD	Liquid Crystal Display
LRIP	Low-Rate Initial Production
LWF	Lightweight Fighter
Majcom	Major Command
MDP	Milestone Decision Point
MLU	Mid-Life Update
MS	Milestone
MSIP	Multi-Stage Improvement Program
MY	Milestone Year
NMS	National Military Strategy
NSS	National Security Strategy
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
PB	Program Baseline
PEO	Program Executive Officer
PM	Program Manager
PPBE	Planning, Programming, Budgeting, and Execution
RFP	Request For Proposal
RWR	Radar Warning Receiver
SAR	Special Access Required
SECDEF	Secretary of Defense
SPD	System Program Director
SPO	System Program Office
T&E	Test and Evaluation
TACAN	Tactical Navigation
UAE	United Arab Emirates